U. S. NAVY MEDICINE

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COVER: HM2 Karen Strashinsky discusses hemophoresis with a donor. The Navy Tissue Bank, Transplantation Branch, Naval Medical Research Institute, Bethesda, MD, is the subject of this month's cover story on p. 6. Photo by HM2 J. Parmenter, USN

The Mysteries of Motivation

*It is a well-known fact of the medical manager's life that health care is one of the most labor intensive industries in the United States. To the military health care manager, the shrinking pool of manpower resources is even more evident. We must do everything in our power to get the most from our people. A Royal Bank of Canada Monthly Letter entitled "The Mysteries of Motivation" made points particularly appropriate for those of us in the health care field. The following is an abstract of that letter:**

Whether in a business big or small, a school, or an association, anyone who is responsible for other people's efforts must grapple with the intricacies of motivation. Therefore anyone who is, or aspires to be, responsible for other people's work should seek a basic understanding of what it is all about. To motivate people, the dictionaries tell us, is to cause them to act in a certain way. In the lexicon of management science, the system of reward and punishment is known as the "carrot-and-stick" approach. The modern worker clearly is motivated by much more than the carrot of pay and advancement and the stick of discipline and insecurity, although it would be foolish to underestimate the continuing effectiveness of these devices.

It is part of normal human nature to steer clear of trouble and to want the assurance of a steady, well-paid job. The function of motivation in modern management is to move workers to perform at the very peak of their abilities. This can only be done through leadership. A leader is able to draw forth a willing effort from his followers and make them want to do their utmost for him. Theories abound about how leaders should go about getting people to drive themselves, but no one disputes the fundamental notion that "high-level" motivation resulting in high-level performance must come from within an individual. It is the sum of a person's aspirations, values, self-esteem, and sensibilities. So it is a person's own property, to be given or withheld depending on how he or she feels about a job. Any attempt to motivate a person to do his or her best work must be tailor-made to the needs of the individual personality. Because of this, the person most responsible for a person's motivation on the job is his or her immediate boss. The top management of an organization can go some way toward meeting creature comfort and security needs, and in offering incentives for good performance. But the more private and particular elements of motivation must be dealt with on a personal level between the superior and subordinate day-by-day. The motivation of each individual in a work team is what goes to make up its morale—and bad morale can spell grief to the leader of any team.

The results of surveys of worker's attitudes in recent years underline the importance of motivation on the ground level. They show that present-day employees place a strong emphasis on challenge, opportunity, and recognition of performance, and that they are more willing than their counterparts of a generation ago to quit a job that does not offer these things. An old-line manager or supervisor might write them off as spoiled brats or prima donnas. But by failing to take account of their personal priorities, he or she could very well have to live with the consequences of a high turnover, which include having to function on a more or less permanent basis with a half-trained staff.

On the other hand, bosses who make a serious effort to understand their subordinates become better motivated themselves, because they come closer to fulfilling their own ego and self-expression needs in the process. The cross-motivation that comes from healthy superior-subordinate relationships gives rise to an ideal working climate, not only for the people directly concerned, but for the organization as a whole. A line manager or foreman may consider it ridiculously beyond his purview to have to worry about whether the people working under him are happy or not. But in the long run his own happiness in his job is bound to be affected by how they feel. If a leader cares about what happens to his followers, his followers will care about what happens to him. If a person's work per se adds to his or her happiness, then the job in itself becomes the ultimate motivator.

It comes down to treating people with respect for their individuality and consideration for their feelings. It means caring about others—about their personal well-being. It means giving them a chance to show what they can do even if that is sometimes inconvenient. It means encouraging and helping them to meet their full potential in their careers. The bosses who are most concerned about their subordinates get the most out of them in the form of high-quality work.

W.P. ARENTZEN
Vice Admiral, Medical Corps
United States Navy

* "The Mysteries of Motivation," *The Royal Bank of Canada Monthly Letter* 61(1), January 1980.

Meet RADM Shea

RADM Frances T. Shea is at the pinnacle of her military career. She is the fourth woman in U.S. Navy history to reach flag rank and is the Nurse Corps' 14th Director. She holds a B.S. degree in nursing from St. Joseph College in Hartford, CT, and an M.S. in nursing service administration from De Paul University in Chicago.

Her previous assignments included nursing positions at the Naval Hospitals, Portsmouth, VA; St. Albans, NY; Chelsea, MA; and Rota, Spain. She was a Nurse Programs Officer in Richmond, VA, Director of Nursing Service at NNMC Bethesda, MD, and NRMC San Diego, CA. One of her most rewarding tours was as Operating Room Supervisor aboard USS Repose stationed in the South China Sea during the height of the Vietnam war.

Among her many decorations, RADM Shea wears the Navy Meritorious Service Medal, Navy Commendation Medal, Vietnam Service Medal with four stars, Vietnamese Cross of Gallantry, Vietnam Civil Action Medal, and Republic of Vietnam Medal.

U.S. Navy Medicine *recently talked with RADM Shea on the occasion of the Nurse Corps' 72nd birthday. She was self-assured, quick to respond, and quite candid in expressing her feelings on at least one controversial subject—the role of the Navy nurse in combat.*

With nearly 30 years of nursing experience behind her and what appears to be limitless energy, RADM Shea is well qualified to lead the Nurse Corps into the 1980s.

USNM—What are your priorities for the Nurse Corps?

RADM Shea—One of my top priorities is to get baccalaureate degrees for as many nurses as possible prior to 1985. If the American Nurses Association goes with its plan calling for B.S. degrees to qualify for entry into practice, I feel we must provide the necessary out-service training programs as rapidly as possible. To accomplish this, we have developed some guidelines to require our undergraduate students to complete their degree requirements within 18 months. Currently, we have nurses who are taking 3½ years or longer. We are encouraging nurses without degrees to attend school on a part-time basis.

Photos by HM2 J. Parmenter

Nurses belong in areas where they can take care of casualties and, if that happens to be in a combat zone, that's where they should be.

Have you been successful?

Oh yes. It's been successful so far. We are also examining other areas where nurses can go to school. For example, we now have two appointments at Baylor University for the graduate Army program in health care administration. We have increased student enrollment in the anesthesia program to 12 each year. Programs at USUHS (Uniformed Services University of the Health Sciences) are also open to us.

Our educational programs are excellent. What I'm really trying to do now is see that two nurses instead of one graduate in a 36-month time frame.

I understand there is a new management course available for nurses under the auspices of HSETC.

Yes. We are trying to make programs available to the nurses in the field. We hope the HSETC staff will be able to develop a prototype for a program that, in effect, will teach the teachers how to teach a management program that would be offered at the medical facilities where nurses are assigned. Instead of a few junior officers coming to Washington to learn techniques of management, we would instruct the same number of experienced man-

agers to become teachers, who then would present the material to the nurses in the field.

Do you think there is enough career mobility in the Nurse Corps?

What we must look for with respect to career mobility is the concept of the military nurse. You can be a nurse in the civilian community and be an educator, a clinician, or an administrator, but there are other ingredients in military nursing. Take, for example, operational medicine as it pertains to nursing. We have four nurse anesthetists on carriers. We have a new requirement for a nurse to be assigned to a Marine Unit at Camp Hansen, Okinawa. We plan to send this nurse to field medical school even though she will not deploy with combat forces. We also have nurses assigned to develop plans for the fleet hospital. There is mobility, and nurses in the 1980s must assume responsibility for operational nursing. If nurses didn't want the excitement and challenge, they wouldn't come into the military.

And isn't that what makes Navy nursing attractive? As a civilian nurse, you may see your career laid out before you and know exactly what to expect. As a military nurse there's that unknown excitement. "Am I going aboard a carrier? Am I going to be assigned to a field unit?"

Exactly. Or, "How can I use my skills as a nurse to assist in operational medicine?" We have what we call a Field Liaison nurse in San Diego. Her job is to go aboard ship and determine what the corpsmen need for in-service education and to help arrange for such training. Perhaps an operating room technician who hasn't had an opportunity to do much assisting on cases or scrubbing may need an opportunity to improve his or her skills by going to a hospital and working in those situations.

RADM Shea looks in on a retired military patient.

Then, you see the role of the nurse as an educator.

Oh yes. Nurse participation is essential in patient and staff education. We are prepared to do it, we're equipped to do it, and we should do it.

Earlier, you mentioned that there is now a requirement for a nurse to be assigned to the Marines on Okinawa and that this nurse would go to field medical school. What's your opinion on women serving in combat zones?

First, I think we must identify what is meant by combat. If this means support activities like a hospital ship, it would be very difficult to tell nurses they don't belong in support areas designated to care for casualties. This might very well be considered a combat zone. They definitely belong and have a responsibility to be there. Do I think

women belong with the Marines on the line in a platoon? Absolutely not, and not for any emotional reasons. Physiologically, it would be extremely difficult for a woman to keep up with a line platoon. If you take a 100-pound woman and ask her to carry a 45-pound pack, that's almost half her body weight. There may be women who could handle it but I think there are relatively few. Anyway, a Marine platoon is not really the place for nurses. They belong in areas where they can take care of large numbers of casualties and if that happens to be in a combat zone, that's where they should be.

What is being done about evaluating standards of nursing practice?

As far as the care of patients is concerned, we have developed standards that are required by JCAH (Joint Commission for Accreditation of Hospitals). These proposed standards have been sent out to selected hospitals and are being evaluated by personnel who are going to work with them. We want standards that can be applied to every hospital. In effect, we want to standardize the standards. We should have these out in another month or two.

We now have a quality assurance nurse and that's a full-time job here at BUMED. The nursing community and JCAH are imposing additional requirements designed to improve patient care. Also, we are involved in patient classification. When staffing a hospital, it's not enough to say that you need so many nurses on AMs and so many on PMs. You must now prove why you need them to care not only for numbers of patients but kinds of patients as well. Actual nursing care hours must be matched with certain levels of nursing service personnel. There are limitations as to how many class 1, 2, or 3 patients a nurse or corpsman can be assigned.

You seem to have quite a broad nursing background. How long have you been in the Nurse Corps?

I joined the Navy in 1951, stayed three years, and then left for six years before coming back on active duty in 1960.

What did you do during those six years?

I was a scrub nurse and an assistant OR supervisor at a VA hospital in Chicago and attended De Paul University for a M.S.N. By the way, I did not leave active duty because I was unhappy; I loved what I was doing. I really left for family concerns and to go to school. I did, however, stay in the Reserves and had some terrific assignments. When I came back on active duty, I knew that this was it. This is what I

RADM Shea admires a new arrival.

Maintaining contact with both nurses and patients is an important part of the Nurse Corps Director's job.

wanted and I felt I was bringing something back in with me—a good education and some additional experience. After that, I did a little of everything. I worked on the wards, helped in the delivery room, the outpatient department, and in the operating room.

Did you have a favorite place to work?

Yes, the operating room, but I liked every part of nursing.

Was there a favorite assignment?

Working aboard a hospital ship was the best assignment of my Navy career and the most rewarding. Everyone worked terribly hard, put in long hours, and never had time to be bored. It was during the Tet offensive.

Now that you are the Director of the Nurse Corps, do you miss the duties you had as a practicing nurse?

Oh sure I do. That's why I sometimes visit the medical center at Bethesda on a Saturday, not only to see patients but staff as well. Things move so quickly in nursing and there are so many challenges and new ideas that there's no way I could keep up without seeing for myself what was happening on the wards. In a hospital situation, you get a lot of support from patients and staff. There's a sense of accomplishment when you see a patient get well or the smile on a mother's face when you bring in her new baby. You don't really have these satisfactions in administrative positions, but as long as I can keep in touch with the nurses and corpsmen on the wards, I feel a lot better about my role. —JKH □

Photos by HM2 J. Parmenter

Technicians prepare to procure tissues from a donor in the Tissue Bank's operating room.

The Navy Tissue Bank

The World's First Still Sets Standards for Others To Follow

Two jumbo jets collide in flames on an airport runway, killing and seriously burning hundreds of passengers.

A young marine on a jungle patrol takes an incoming mortar round and loses part of his jaw.

A 17-year-old dependent develops a life-threatening malignancy involving her right femur.

A college professor begins a regular dialysis program after his kidneys fail.

At one time, the prognosis for such patients would have been bleak. But today, thanks to tissue banking, medical science offers them the chance to lead normal, active lives once again. The burn

victims received skin grafts and other treatment at special burn centers. Oral surgeons reconstructed the marine's jaw and mouth. The teenager received a bone graft, enabling her limb to function once again. With a transplanted kidney, the professor no longer depends on dialysis for survival.

The concept of storing human tissue for transplantation was put to practice in 1949, when the Naval Medical Research Institute (NMRI) set up the world's first tissue bank in a wing of the Naval Medical Center in Bethesda, MD. The Tissue Bank was designed to supply allograft material to treat war-related injuries such as burns and severe fragment damage.

While maintaining this standby capability, the Tissue Bank has expanded its peacetime activities. It not only procures, prepares, and stores tissue but also conducts research on tissue and organ transplants. Such work is performed at Tissue Bank facilities and with cooperating civilian surgeons throughout the world.

The science of freeze-drying human tissue began in the Tissue Bank's Bethesda labs. Today, researchers there continue to investigate such transplant-related areas as histocompatibility (tissue-matching) and the immune response. What mysterious trait of freeze-dried allograft material stimulates the body to grow new tissue? How long can a human kidney be stored? Is it possible to selectively suppress the body's immune response, so that the transplanted organ will not be rejected?*

As the search for these answers goes on, a partnership with the civilian medical community helps find new ways to utilize transplanted tissue. The Tissue Bank provides allograft material to military and civilian surgeons and researchers, who use it to treat seriously injured patients. All tissue requests are carefully screened. In exchange for the tissue, the recipient surgeon or research institution signs a collaborative agreement to provide all pertinent clinical data on the patient. In this way, the patient benefits and the Tissue Bank is able to study transplanted allografts in trauma settings not always available in the peacetime military.

Since this partnership began over 30 years ago, the Tissue Bank has collected over 40,000 tissue deposits from some 1,500 donors and over 11,000 military and civilian recipients have been benefactors.

Tissue Procurement

What kinds of allograft material does the Bank handle and where does it come from? The tissues include fascia, dura, skin, bone, ligaments, tendons, and even blood vessels. Cadavers are the source and the criteria are strict. The chance of disease transmittal from donor to recipient is virtually eliminated by the Tissue Bank's screening process. Potential donors with histories of carcinoma are disqualified as are those with the presence of such infectious diseases as encephalitis, meningitis, viral hepatitis, malaria, syphilis, tuberculosis, diseases of unknown origin, and autoimmune maladies. Donors are considered ineligible who were on high steroid doses, had major surgery within 48 hours prior to death, or who may have succumbed to poisoning.

The majority of donors selected for tissue procurement are patients who die at the National Naval Medical Center. However, because the demand for organs and tissues far outweighs the supply obtainable from NNMC donors, the Tissue Bank must procure material from other sources. To do this, a "fly away" capability has been developed. A procurement team, always on call, can be flown by helicopter or fixed-wing aircraft when a suitable donor becomes available elsewhere.*

After a death occurs, the Decedent Affairs Office notifies the Tissue Bank. Tissue Bank technicians then review the patient's medical records. If this initial screening is successful, a medical officer reviews the chart, permit forms are prepared, and Tissue Bank representatives visit the next-of-kin and formally request the tissues. They describe what tissues are needed and how each will be utilized.

In the case of a patient whose death may be imminent, permission is obtained in advance, and when death occurs, kidneys are procured in the hospital OR. Unless these organs are immediately transplanted, they must be maintained in a cold slush solution for a short time or on a kidney perfusion machine for no longer than 72 hours.

In the procurement of tissues that do not remain viable such as bone or skin, the donor is brought to the Tissue Bank, shaved, scrubbed, and prepped as if for surgery, and the remains are then wheeled into a scrupulously maintained stainless steel OR for the procurement. This room, when not in use, is bathed with ultraviolent light to cut down the ambient flora. All incoming air is filtered. A positive pressure ven-

*The Tissue Bank is involved in a combined Army-Navy kidney transplantation program centered at the Walter Reed Army Medical Center, Washington, DC. There, animal studies done at NMRI are applied in a clinical setting.

*Presently, the Bank uses aircraft from the Naval Air Facility at Andrews Air Force Base, MD, Marine Helicopter Squadron 1, Quantico, VA, and two Army squadrons from Davison Army Air Field, Fort Belvoir, VA, Military District of Washington.

tilating system insures that no contaminated air flows in from outside. Monitoring is completed by taking periodic cultures.

Once in the OR, a team of two to four gowned and scrubbed technicians drape the remains and begins procuring skin, fascia, lower and upper extremity bones. The team also removes the fifth, seventh, and ninth ribs. Occasionally, permission to remove the mandible is obtained. The team then closes all wounds, long bones are replaced with dowels, and contours are packed to restore a natural appearance. The missing mandible is replaced with an artificial one, and when completed, the remains are strictly suitable for viewing.

Quality Control and Preservation

Processing and further screening of the tissue now begins. Extraneous tissue is removed from the long bones in the sterile environment of the OR and technicians further process them into usable shapes and sizes. They granulate cancellous and cortical bones into finer pieces. Long bones are trimmed; soft tissue is rolled in fine mesh gauze. The tissues are triple-wrapped in sterile towels for storage in the Tissue Bank's liquid nitrogen freezers.

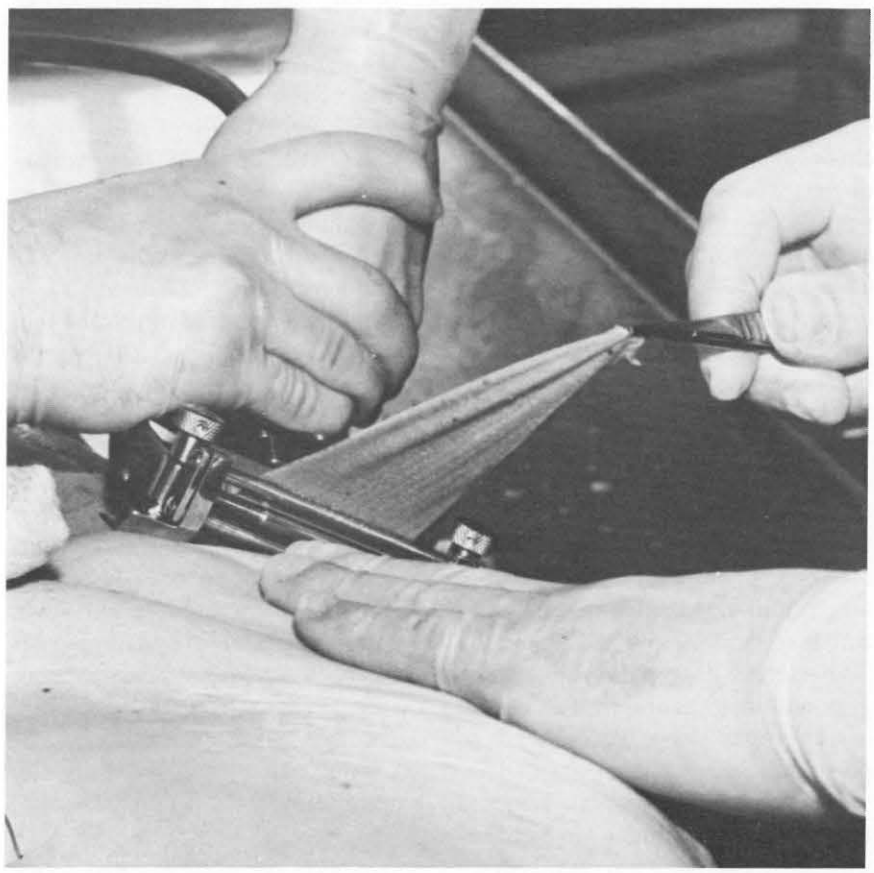
Cultures are important in the procurement process. Technicians culture blood as well as each tissue specimen. The presence of any organism precludes transplantation. The autopsy must also prove negative for cancer, tuberculosis, or serious infection.

All nonviable allografts are stored in the Bank's liquid nitrogen freezers, which are maintained at -196° C. Such temperatures are necessary to prevent enzymatic degradation of tissue.

Once the tissues pass through strict quality control tests, they are bottled and freeze-dried. This carefully controlled process occurs in the previously gas-sterilized freeze-dryer. It removes all but about five percent of the tissues' moisture. At the end of the freeze-drying cycle, which may last from one to two weeks, the bottles are sealed within the chamber and removed. As long as room air is kept from entering the containers, the tissues can be stored at room temperature indefinitely.

Freeze-dried tissue containers are tested periodically using a static spark tester. A purple glow within the bottle insures that the vacuum and sterility have been maintained.

In those cases where tissues have been procured in other than sterile conditions, or the vacuum seal on a freeze-dried specimen has been compromised, the tissue can be irradiated to restore sterility.



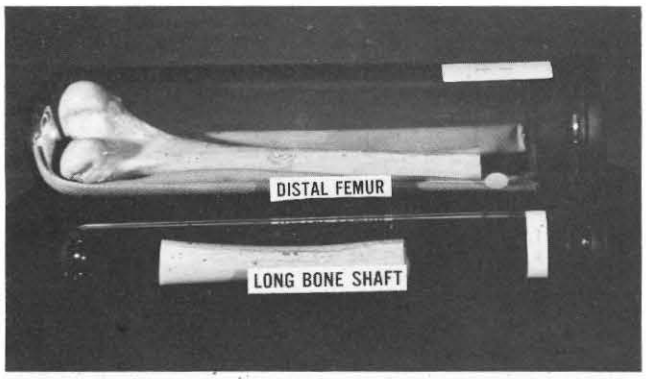
Technicians collect skin with an electric dermatome.

Tissue Use

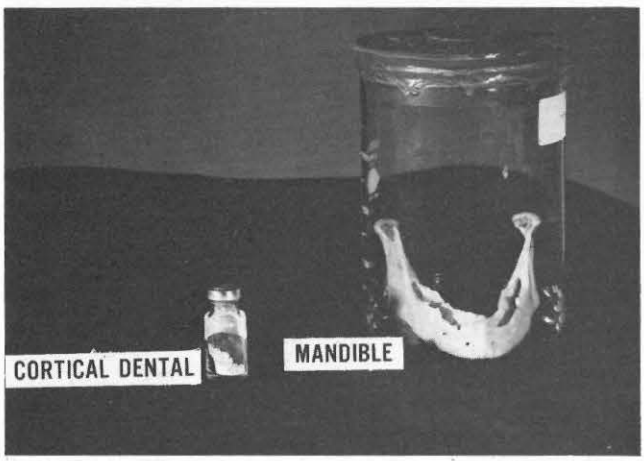
Because freeze-drying decreases the problem of rejection found in transplanting viable tissues, tissue-typing and donor-recipient matching are unnecessary. Therefore, freeze-dried skin, fascia, dura, and bone are the most common and successful allograft materials in the Tissue Bank's inventory.

Before use, most of these allografts require rehydration, especially bone, which becomes extremely brittle. The exception is crushed cancellous and cortical bone. These grafts can be packed directly into osseous defects without reconstitution; body fluid restores needed moisture. Soft tissues require rehydration to restore plasticity.

Although freeze-dried bone is less immunogenic, implantations of massive bone grafts such as femurs



Freeze-dried bone in sterile, vacuum-sealed containers.

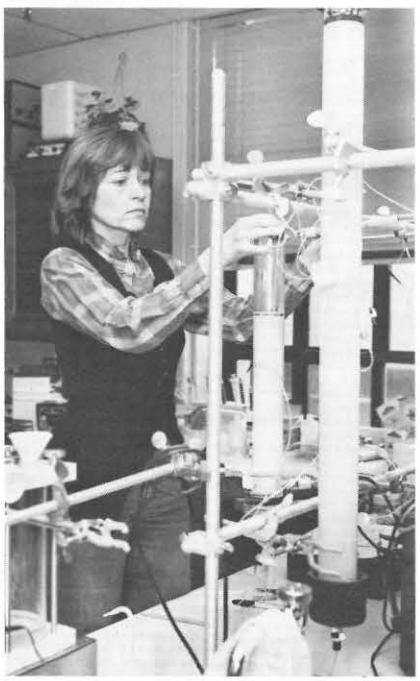


After procurement, a long bone shaft is cut into strips and processed into usable matrix.

are more successful when fresh-frozen bone is used. Tissue-typing is carried out with these transplants under a research protocol.

Research

Tissue-typing for the transplanting of viable tissues is only a small part of the Histocompatibility Lab's capabilities. The Lab, one of the Tissue Bank's main research arms, is heavily committed to studying rejection and how to control it. One spinoff from this research was the discovery that the transplantation antigens in man—the HLA system—are also associated with susceptibility to disease. This helps explain why some populations are prone to certain infections. Histocompatibility studies of the immune response mechanism have given new clues to the possible causes of cancer, juvenile-onset diabetes, and other ills.



Technician Judy Jones adjusts column used for fractionating serum proteins.

HM2 Thomas Froelich examines roller-bottle tissue cultures in a walk-in incubator.

A procurement team can be flown by helicopter or fixed-wing aircraft when a donor becomes available elsewhere.

The Histocompatibility Lab's involvement in bone marrow transplantation relates to marrow's use in treating aplastic anemia and some of the leukemias. Aplastic anemia can result from a radiation accident, not an unthinkable possibility in a nuclear-powered Navy.

To perform much of this research, sophisticated machinery separates blood into its components. A unit of blood drawn from a donor is circulated through a hemophoresis machine and blood components are taken off as platelets, white cells, or plasma. The components needed are collected in blood bags and what remains is then returned to the donor. By collecting components in this manner, the Lab's researchers are able to examine new reagents, new antigens, and study the mysterious HLA system. In one hour, a donor can provide enough reference cells to last two or three years.

Other research directly related to tissue transplantation continues elsewhere in the Tissue Bank or in NMRI's animal labs. There has been a renewed interest in comparing the effectiveness of freeze-dried allografts to fresh-frozen ones. Is fresh-frozen skin better for treating burns than its freeze-dried counterpart?

Researchers are also zeroing in on freeze-dried bone, hoping to isolate the enigmatic osteogenic factor that stimulates bone growth.

The Tissue Bank as a Prototype

If imitation is the highest form of flattery, the Navy Tissue Bank's position as the world's prototype is assured. There are only three comprehensive tissue banks in the entire United States, and one of the other two was founded by a former Navy Tissue Bank Director. Foreign delegations have visited the Tissue Bank with the idea of creating similar institutions. For example, the Canadian Government used the Tissue Bank as its model in supporting the creation of a similar facility in Edmonton, Alberta.

Plans for other banks in this country and abroad are underway. The American Association of Tissue Banks, established by former Bank Director Dr. Kenneth Sell, will set standards for procuring, processing, storing, and shipping tissues and organs for many of these banks.

In the meantime, the research goes on, much of it in the institution where it all began. Ultimately, transplantation research may enable surgeons to graft entire limbs, which would have startling implications for treatment of war wounds and peacetime injuries. Some researchers believe this breakthrough could come in the not too distant future. If and when it does, chances are the Navy Tissue Bank will somehow be involved. —JKH

"I Want To Con the Body Into Making New Bone . . ."

Although the Navy Tissue Bank is both a processing and storage facility for human tissue, its chief function is researching the field of tissue and organ transplantation. This includes the study of histocompatibility, immunology, and techniques related to the use of nonviable allograft materials and viable organs.

CDR Douglas M. Strong, MSC, USN, is a research scientist and Director of the Transplantation Research Branch of the Naval Medical Research Institute, of which the Tissue Bank is a part. He and LT Joseph G. Matthews II, MC, USNR, the Bank's tissue procurement officer, are deeply involved in investigating the usefulness of allograft material and evaluating its potential applications to naval medicine.

U.S. Navy Medicine *recently talked with Dr. Matthews about his work in tissue research.*

USNM: What types of tissue are you dealing with?

Dr. Matthews: Mostly nonviable tissues such as bone, connective tissues, and skin. These materials can be freeze-dried or frozen and stored long-term. They are not used to provide missing cells to the recipient but rather to provide something necessary for his own body to reconstruct a damaged organ or a missing piece of bone. If you remove a piece of damaged bone from a wounded sailor and wish to replace it, you can take bone from our stores, slip it in, and his body will get the message to lay down new bone around that matrix. This is the basis of the work I'm doing now.

What results are you getting?

Very encouraging results in both animals and humans. The most dramatic results occur using bone grafts, but we have demonstrated the usefulness of skin for covering burn wounds and large skin avulsions. We are currently harvesting skin, freeze-drying, and storing it. There are negotiations underway with a burn center to conduct a side by side study of our freeze-dried skin with their locally procured fresh skin from cadavers.

Fascia is another promising material. It is a dense, connective tissue ubiquitous in the body. It has been used to provide connective tissue in the case of, for example, a drop foot. Where the control of the foot has been lost, fascia can be used to sling the foot up and make it a more useful limb. Fascia has also been used in some maxillofacial reconstruction.

Is this also nonviable tissue?

Yes. Don't let the fact that it is nonviable bother you. It is still extremely useful. In some cases, the fact that it is nonviable is a plus. One investigator working with blood vessels compared those vessels that were allowed to die in the freeze-drying process with those that were protected during freezing and kept alive. The results were better with the nonviable material. The body incorporated the graft and laid down new, living cells.

That brings us to blood vessels. Results of animal work that has been done suggests that we might want to take another look at freeze-dried vein grafts as a source for vascular patches for the battle casualty —the man who gets hit with a high velocity missile and has a hole torn in an artery in his leg. We know that you can take a vein from that leg or from the other leg, make a patch, and put it over the hole. This, however, requires another operation and the loss of the body's own structure. Our animal work suggests that you could take this same kind of vein from a cadaver, put it on the shelf for five years and, when the injury occurs, take it off the shelf and use it to repair the wound.

How far have you progressed in this research?

Photo by HM2 John Dietrich

Dr. Matthews

We are doing the applied work with animals and then will be moving into the human studies.

Dura is another material we're working with. This is a dense, connective tissue that covers the brain. It can be implanted into dural defects in trauma victims. A bullet wound to the head, for example, can cause the brain to swell out through the hole. The defect must be corrected. All types of materials have been tried, including gold foil and fascia. What you want is to provide the neurosurgeon with something he can use to repair trauma or a defect caused by the removal of a tumor. Dura is taken from cadavers at the time of autopsy. Right now, we have a good supply on hand.

Is there a large demand for it?

In peacetime, there is not really a large demand for it, at least in the Navy. In fact, I have just been contacted by a large hospital in Texas that wants to provide us with a trauma series. This civilian hospital gets head trauma cases on a daily basis and has many cases where dura can be utilized. We will provide dura to the trauma center at no cost. How can we justify this? What they will provide to us in the way of data is worth much, much more than the cost of the tissue. If we had to conduct clinical trials on dura or any other allograft material, we would have to pay for the care of those patients. I'm talking about a series of 12,000 patients. The cost would be unbelievable. So, donating the dura is beneficial both to the center and to us.

Cooperation in tissue research is essential. If we had to limit our research in humans to military patients in peacetime, that would be very tough. There just aren't enough military patients that would need a bone or skin graft. We have to open up our research to trauma and tumor centers.

Why tumor centers?

In many cases the ablative surgery required to excise tumors approximates traumatic wounds. When a tumor is removed from a bone, you have, in many respects, the equivalent of a gunshot wound. You can slip a piece of bone in the defect and base your research on the results.

How does a researcher obtain tissue from the Bank?

A surgeon who collaborates with us is not merely a GP. He must be a trained surgeon. We have over 3,000 surgeons who are making news in orthopedics and other specialties. They come to us with a specific case, send x-rays, a summary of the patient, tell us what they need, and what they can do for us. All sign agreements stipulating that they will support our research and not use tissue for any other purpose. We get tremendous cooperation.

What is being done with muscles and tendons?

As far as tendons are concerned, they have taken a lower priority because good alternatives are being investigated in the civilian community. There is really no demand right now.

We are looking into uses for the rotator cuff, a specialized tendon that attaches the muscles of the shoulder as they connect to the humerus. The information we get from this gives us information in general about grafting various nonviable tissues in humans.

Nonviable tissue then, has an advantage over synthetic substitutes?

Oh yes. Synthetics often fail. Plastics and metals wear out. There are fundamental problems with total hip replacements, even though I'm not projecting that they will go out of style. I simply have a conceptual problem with the idea of taking a nonliving material like bone cement and binding it to living, dynamic tissue like bone. It should be no surprise that loosening is a problem. My interest is in challenging the body to lay down new bone where you want it, whether it is a segmental defect or a cavity that's been created by a tumor. I want to con the body into making new bone where it wouldn't ordinarily appear.

What problems do you encounter with rejection of nonviable tissue?

If you take a vital skin graft and apply it to a recipient, his immune system is alarmed by its presence and responds to destroy the intruder. If you take that same skin and freeze-dry it, all the cells die. When you remoisten it and apply it, the cell markers on the outside of the cells that tell the body whether it should be there or not are no longer active. We have detected little or no immune response to the freeze-dried or frozen graft material.

You mentioned replacing a section of bone and, in effect, tricking the body into laying down new bone. How much new bone is created when you insert a nonviable graft into the link?

It varies. There are factors that need clarification before we can control how much bone is laid down. Some of us feel that the bone, whether it is viable, nonviable, or freeze-dried, contains some unknown factor—a protein, an electrical charge, or something—that tells the body to manufacture new bone cells. Whatever the unknown characteristic is, we are obviously transplanting it when we implant bone because of how the body reacts. We know that if you autoclave bone or treat it chemically, the unknown factor is destroyed and the bone

graft is resorbed. If we could isolate the substance and manufacture it, we could perhaps supply our surgeons in the future with some kind of powder to sprinkle into bony defects to stimulate bone growth. I realize that this is all very futuristic, but even now all this research has very dramatic potential. The tissue typing research is bound to have spinoffs. We are learning incredible things about how the body heals itself.

You mentioned earlier that allograft material is sometimes used in maxillofacial reconstruction and repairing dental defects.

Yes. Bony defects are being treated using a finely ground bone we produce here. It is packed into voids or extraction defects or areas that have been eroded by oral disease. This material is doing just what I would like it to do; it is stimulating new bone growth. We have a large series of oral surgery cases, the results of which will soon be analyzed by computer. Periodontists are also using our freeze-dried skin to repair gingival defects.

Is this actually gingival tissue?

No, it is skin from other sites. It serves as a matrix but researchers are actually getting incorporation of this material. So far, both animal and human studies have been extremely promising.

How do you practically apply all this research to a military situation?

Suppose that sometime in the future, a young marine walks down a road in the Middle East and steps on a land mine. In past conflicts, his badly injured leg might have had to be removed. If we could provide a material that was a good alternative to amputation, we could give that man treatment that would restore continuity and function to his leg. We have to develop this capability in the Navy. If my research on how to augment bone formation works to my expectations, we will really have something. □

Transplant Glossary

Allograft
A graft of tissue between individuals of the same species (previously called a homograft).

Antigen
Any substance capable, under appropriate conditions, of inducing the formation of antibodies and of reacting specifically in some detectable manner with these antibodies.

Autograft
A graft of tissue derived from another site in or on the body of the organism receiving it.

Autoimmune
An immune reaction directed against the body's own tissue.

Dura mater
The outermost, toughest, and most fibrous of the three membranes covering the brain and spinal cord.

Fascia lata
A sheet or band of fibrous tissue that shields the muscles of the thigh. Has been used successfully in limited muscle reconstruction and maxillofacial repairs.

Hemophoresis
The process of drawing blood, separating and collecting its components for transfusion, and returning portions back to the donor (e.g., red cells and plasma).

Histocompatibility
The compatibility of tissues as cells between donor and recipient.

Human Leukocyte Antigen (HLA)
Histocompatibility antigens on the surface of nucleated cells determined by a major chromosomal region. Important in matching for transplantation and susceptibility to certain diseases.

Immune Response
The development of antibodies in response to an antigenic challenge. The challenge may be the introduction of an incompatible tissue.

Tissue-Matching or Histocompatibility Typing
A method of measuring the degree of tissue compatibility between two individuals.

The Gift of Life

In the United States at any given moment, several thousand patients are being treated by kidney dialysis. As many as 30,000 are potential candidates for kidney transplant. Those in need of corneas to correct sight can wait from many months to years for a donor. The availability of bone for transplantation is very limited and, in the event of a serious emergency, large amounts of skin would be needed to treat burn victims.

The need for both viable and nonviable graft materials, in short, far exceeds the supply. In the past, permission to harvest tissue from a deceased had to be obtained from the next-of-kin. Now, all 50 States adhere to the Anatomical Gift Act, which enables a person to grant permission to donate his or her remains at death. Several States have even provided a means for doing so in the event of sudden, accidental death—permission is granted on the driver's license.

The Uniform Donor Card is one way a potential tissue donor can insure that his or her remains will be utilized in accordance with the Anatomical Gift Act. A card can be obtained from the American Medical Association, 553 North Dearborn, Chicago, IL 60610. Once witnessed and signed, the card should be carried at all times.

CARDS FOR YOU TO USE

UNIFORM DONOR CARD

OF _____
Print or Type name of donor

In the hope that I may help others, I hereby make this anatomical gift, if medically acceptable, to take effect upon my death. The words and marks below indicate my desires.

I give (a) ____ any needed organs or parts
(b) ____ only the following organs or parts

_____
Specify the organ(s) or part(s)

for the purposes of transplantation, therapy, medical research or education.

(c) ____ my body for anatomical study if needed

Limitations or special wishes, if any _____

Signed by the donor and the following two witnesses in the presence of each other:

_____ _____
Signature of Donor Date of Birth of Donor

_____ _____
Date Signed City & State

_____ _____
Witness Witness

This is a legal document under the Uniform Anatomical Gift Act or similar laws.

UNIFORM DONOR CARD

OF _____
Print or Type name of donor

In the hope that I may help others, I hereby make this anatomical gift, if medically acceptable, to take effect upon my death. The words and marks below indicate my desires.

I give (a) ____ any needed organs or parts
(b) ____ only the following organs or parts

_____
Specify the organ(s) or part(s)

for the purposes of transplantation, therapy, medical research or education.

(c) ____ my body for anatomical study if needed.

Limitations or special wishes, if any _____

Signed by the donor and the following two witnesses in the presence of each other:

_____ _____
Signature of Donor Date of Birth of Donor

_____ _____
Date Signed City & State

_____ _____
Witness Witness

This is a legal document under the Uniform Anatomical Gift Act or similar laws.

You can clip, fill out, and carry one of these cards. Do not send the completed card to the American Medical Association.

An Investigation of Assessment Techniques for Body Composition of Women Marines

MAJ Howell F. Wright, USMCR Charles O. Dotson, Ph.D. Paul O. Davis, Ph.D.

Obesity is a major deterrent against high levels of health and physical fitness. The relationship of obesity to health problems such as diabetes, hypertension, and heart disease has been well documented. (*1,7,11,14,15,16,18,20*) Without question, those individuals who carry excess fat cannot perform physical fitness related tasks as well as those who are proportionally lean. Two questions that stem from these statements are "How much fat is too much fat?" and "How may the amount of fat in an individual be accurately assessed?"

Before these questions can be answered, the difference between overweight and overfat or obesity must be understood. The concept of overweight normally considers total body weight as it relates to an individual's height. The traditional height/weight tables have been shown to have considerable limitations in predicting optimal body weight. (*21,27*) They unfairly penalize those individuals with large frames and high lean mass, and allow individuals with low lean mass and high percentages of body fat to remain obese. A more appropriate concept is to refer to total body fat as a percentage of total body weight. In addition, the term overfat (or obese) should replace the word overweight as the label applied to individuals whose body fat percentage exceeds that considered to be acceptable.

Expressing fat as a percentage of total body weight has several advantages. First, it relates directly to the problematical area—fat content. Secondly, it does not depend on variables such as height and frame size. Since performance and appearance are hindered by fat in excess of normal, a definition of obesity should be established that reflects the needs of the Marine Corps. Obviously, the lower the percentage of fat, the fewer the fat-related problems.

There are many techniques for determining the amount or percentage of body fat. Unfortunately, the validity of these techniques seems proportional to their expense and technical difficulty. Physical methods include body density determinations and radiographic analyses. Biochemical approaches such as Potassium-40, isotopic dilution, and inert gas absorption are also accepted laboratory procedures. Of all the approaches, one of the most accurate and widely used methods is hydrostatic weighing. This technique is based on Archimedes' basic physical principle that states, "A body immersed in a fluid is acted on by buoyancy forces which is evidenced by a loss of weight equal to the weight of the displaced fluid."

Since these laboratory techniques do not lend themselves to field situations, other methods have been developed using less precise instrumentation. Anthropometry is a term that applies to the measurement of external aspects of the body, such as body diameters, circumferences, and skinfold thickness. Generally, anthropometric measurements are easy to obtain and required instrumentation is relatively inexpensive. For these reasons, a very large number of formulas for predicting percent fat of women have been developed using one or more anthropometric measurements. A problem exists in that these formulas tend to be population specific. (*2,9,19,24*) If percent body fat is utilized as the criterion for being overfat (obese) and a field test is needed to determine percent body fat, then an anthropometric formula

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TABLE 1. Age and Physical Characteristics of the Test Group (N = 181) and Validation Group (N = 45)

Variable	Mean		SD		Range	
	TG	VG	TG	VG	TG	VG
Age, yr.	23.1	23.7	5.94	5.2	18-47	18-44
Height, cm	164.32	165.7	6.34	5.4	144.8-181.0	155-177
Body Density, gm/cc	1.046	1.049	.0132	.014	1.016-1.096	1.013-1.084
Relative Fat, %	23.11	21.7	5.94	6.3	1.54-37.07	6.7-36.3
Weight, kg	59.34	60.0	6.71	8.1	40.7-79.85	43.3-80.7
Lean Body Weight, kg	45.42	46.7	4.66	5.3	32.6-55.8	30.6-56.8
Total Body Fat, kg	13.7	13.9	4.6	4.4	2-29.5	2.5-29.0
Residual Volume, liters	1.516	1.533	.34	.35	.7-2.7	.8-2.5

must be used that has been validated against a sample of the population for which it is intended.

This study was conducted in order to develop a percent fat assessment technique suitable for women marines. In order to investigate the assumption that regression equations for predicting percent fat are highly population specific, previously developed equations were also analyzed.

Materials and Methods

All research was conducted in Fairfax, VA, in the Institute of Human Performance Laboratory. Headquarters Marine Corps in Arlington and Marine Corps, Development and Education Command at Quantico, VA, are both located within 30 miles of the Institute. A total of 499 women marines were assigned to these commands with approximately 37 percent at Headquarters and 63 percent at Quantico. Using these percentages, 93 and 157 participants were selected from Headquarters and Quantico, respectively. Realizing that approximately one-half of the available population was to be utilized, the "coin toss" technique was used for subject selection. Of the initial group of 250 marines, acceptable data were collected on 226 women. In order that equations developed as a result of this study could be validated, a validation group of 45 subjects was randomly selected from the test population. This left a test group of 181 participants. The physical characteristics of both the test and validation groups are given in Tables 1 and 2. Figures 1 and 2 present the relationship of the test group to the Women Marine Corps population on the basis of age and rank.

The subjects reported to the laboratory in one group of five at 0900 and another group at 1300. All were in the postabsorptive state. Prior to being tested each subject was given the opportunity to void and defecate. As a uniform, each subject was provided a nylon two piece, string bikini to wear during data collection.

The anthropometric assessment included 10 skinfolds, 17 girths, and 9 diameters. Two independent anthropometric measurements were taken at each of these sites as listed in Table 2. A third measurement was taken for height, weight, circumferences, and diameters if there was a difference of more than one percent in the first two measurements. Not more than 0.9 mm was accepted for the difference between repeated skinfold measurements. The mean of the two closest measurements was used for final analysis.

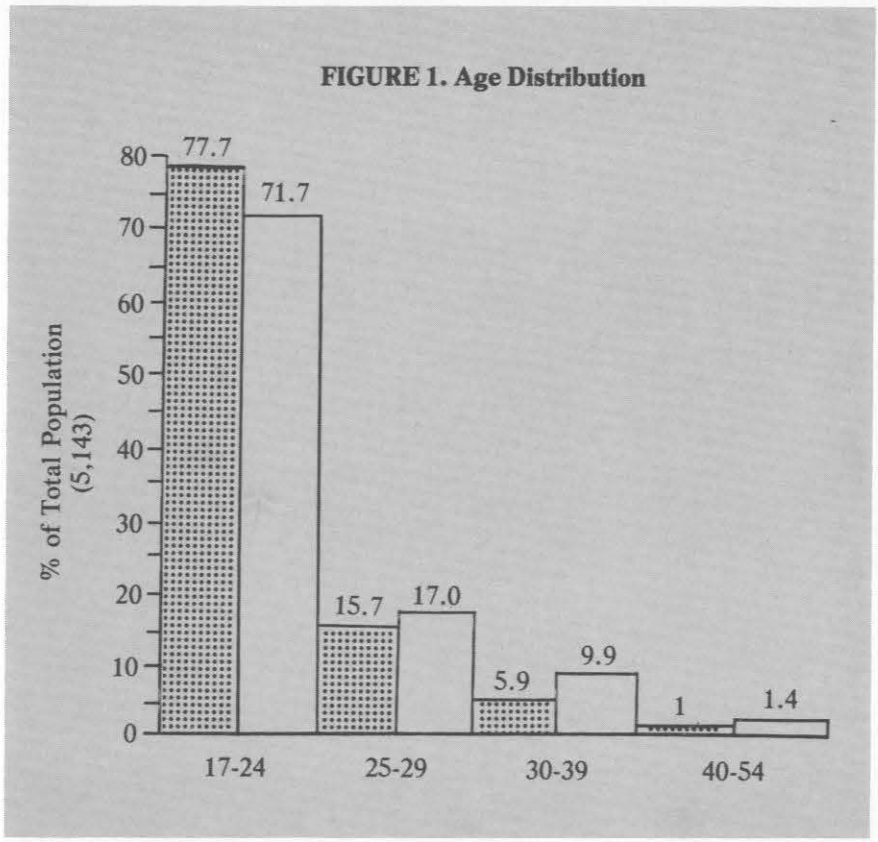
Skinfolds were assessed with a Harpenden skinfold caliper,* diameters with a Siber precision GPM anthropometer,** and circumferences with a Gulick-type cloth tape. All measurements were taken with the subject in a standing position, with the exception of the knee di-

*H.E. Morse, Co., 455 Douglas Ave., Holland, MI.

**No. 101 anthropometer. Siber Precision Inc., 450 Barell Ave., Carlstadt, NJ.

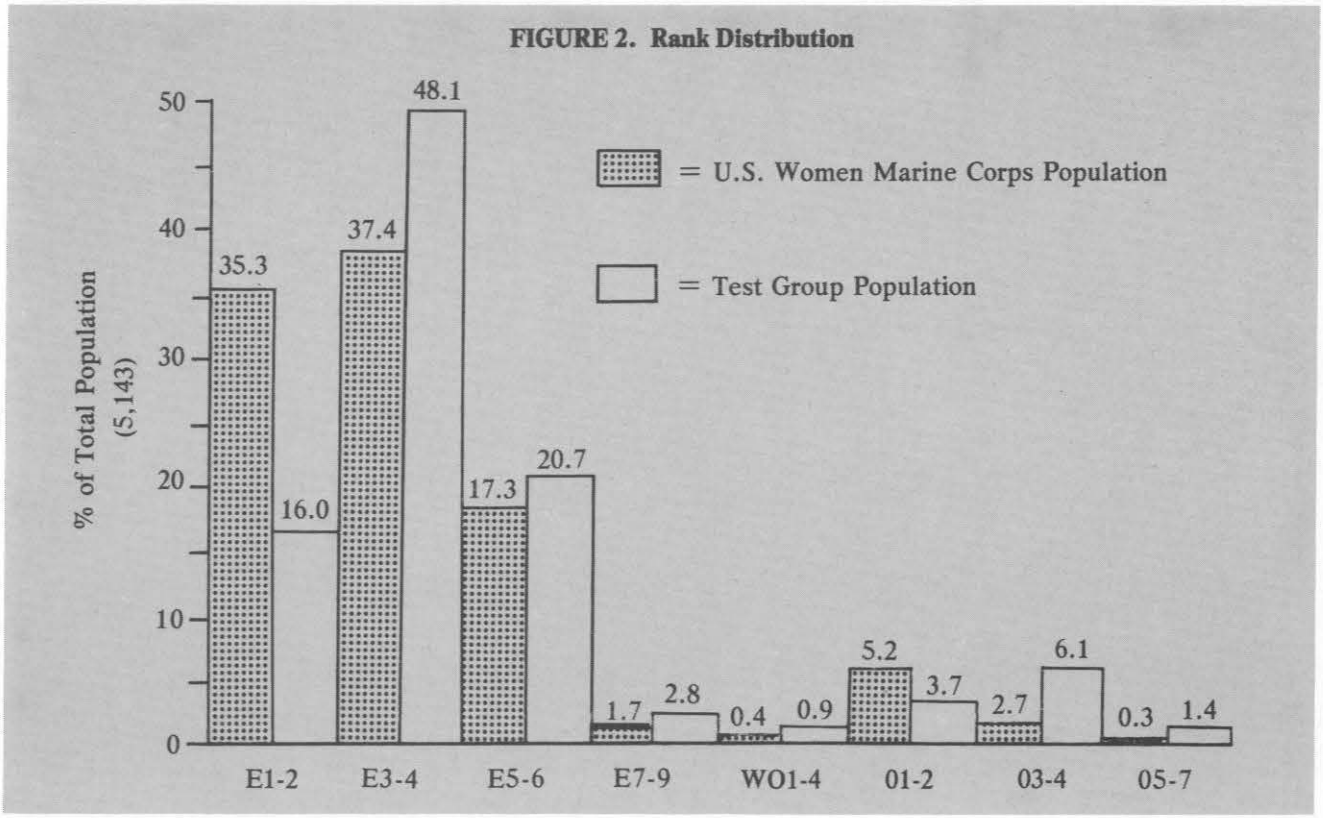
TABLE 2. Mean Values of Anthropometric Measurements and Age, and the Respective Correlations with Percent Fat and Lean Body Weight in the Test Group (N=181) and Validation Group (N=45)

Anthropometric Measurement Site	Mean		±SD		Correlation with: % Fat		Lean Body Weight	
	TG	VG	TG	VG	TG	VG	TG	VG
Age, yr.	23.1	23.7	5.94	5.22	−.05	−.06	−.09	−.10
Height, cm	164.3	165.7	6.34	5.39	−.03	.02	.42	.61
Weight, kg	59.3	60.0	6.71	8.10	.46	.50	.74	.79
Skinfolds, mm								
Subscapula	14.2	13.3	5.67	.06	.56	.50	−.49	.16
Tricep	16.6	15.6	5.67	.05	.67	.68	−.59	.07
Calf	25.5	25.5	6.74	.07	.56	.46	−.47	−.07
Mid Axillary	10.8	10.7	4.35	.06	.58	.58	−.49	.15
Suprailliac	17.2	16.5	7.48	.08	.63	.61	−.53	.08
Chest	20.5	19.7	7.06	.07	.60	.60	−.51	.00
Bicep	7.2	7.2	2.48	.03	.65	.48	−.58	−.01
Abdomen	21.8	21.9	8.30	.08	.69	.67	−.59	.08
Thigh	27.7	27.6	7.83	.08	.66	.78	−.59	−.01
Knee	5.8	6.1	1.40	.02	.17	−.17	−.05	.36
Girth, cm								
Calf	34.4	34.3	2.21	.02	.33	.44	.02	.49
Ankle	21.1	21.4	1.14	.01	.14	.07	.20	.54
Deltoid	29.6	29.3	1.91	.02	.36	.43	−.02	.70
Bicep E	24.7	24.5	1.76	.02	.49	.42	−.25	.64
Bicep F	27.0	26.8	2.01	.02	.35	.34	−.05	.69
Forearm	23.5	23.4	1.30	.02	.20	.21	.20	.72
Wrist	15.0	15.1	0.70	.01	.10	.15	.29	.65
Neck	30.7	30.7	1.21	.01	.15	.00	.18	.73
Shoulder	99.3	99.5	4.56	.05	.29	.29	.10	.74
Bust A	83.8	83.7	4.29	.05	.39	.34	−.05	.69
Bust	85.9	85.9	5.26	.06	.48	.44	−.23	.64
Bust B	73.9	73.6	4.41	.04	.34	.47	−.06	.61
Abdomen 1	69.1	69.2	4.72	.06	.56	.59	−.37	.49
Abdomen 2	78.4	78.3	6.87	.08	.62	.72	−.46	.32
Hip	96.0	96.7	5.27	.07	.58	.66	−.41	.60
Thigh	56.5	56.6	4.02	.04	.59	.65	−.42	.57
Knee	34.7	34.8	1.85	.02	.43	.49	−.11	.56
Diameter, cm								
Biacromial	31.4	31.3	1.67	.02	−.12	−.22	.40	.55
Bideltoid	40.7	40.6	1.95	.02	.20	.27	.24	.75
Chest	25.1	25.2	1.44	.01	.17	.35	.15	.49
Bi-iliac	28.1	28.1	1.83	.02	.47	.64	−.23	.44
Bitrochanter	33.6	33.8	1.87	.02	.52	.66	−.29	.50
Knee	8.9	8.9	.56	.01	.39	.60	−.14	.44
Ankle	6.1	6.2	.35	.00	−.13	−.02	.43	.64
Elbow	6.0	6.0	.34	.00	.14	.29	.21	.58
Wrist	4.9	5.0	.29	.00	−.18	.11	.37	.34



ameter, where the subject assumed a seated posture. A height measuring device was contructed by affixing a GPM anthropometer to a wall, allowing the sliding vernier arm to be placed on the subject's head. All instruments were checked for calibration prior to testing each morning and rechecked periodically throughout the daily testing periods. One investigator, thoroughly trained prior to this study, performed all of the anthropometric assessments. A separate individual recorded all data and informed the investigator when third measurements were required.

Body density was determined using the underwater weighing technique as described earlier. (*5*) The underwater weighings were conducted in a specially designed tank measuring 4.5 ft. (length) x 4.5 ft. (width) x 5 ft. (depth). A 9 kg scale with 10 gm divisions was used to measure the underwater weight



and a Holmes platform, balance-beam scale was used to measure the body weight in air with $\pm$ 0.05 kg. The water temperature was maintained at 32 $\pm$ 1° C. Relative fat was estimated by the equation of Siri.* (*22*)

The procedures used for the underwater weighing have been described previously. (*25*) A minimum of 10 consecutive determinations was obtained for each subject to decrease the intra-individual variability as demonstrated by Katch *et al.* (*13*) The selection of the representative underwater weight was based on one of the following criteria: 1) the highest obtained weight of the 10 observations if it was observed more than twice; 2) the second highest weight if it was observed more than once and if the first criterion was not attained; or 3) the third highest weight if neither the first nor the second criterion was attained.

Two residual lung volume determinations were conducted using the single breath Nitrogen wash-out technique on an Ohio Instruments 840 pulmonary function apparatus. If the test-retest residual volumes were within 200 ml, the mean was used in the calculation of body density. If at any time, differences exceeded this value, a third test was administered and the mean of the two closest tests was used. A subject's data were not included in the study if replicate residual volumes were not obtained on three trials. A 100 ml deduction was made for the presence of gastrointestinal gas.

Data reduction, screening, storage, and all statistical analyses were carried out on the Univac 1100 series computer employing the Biomedical Computer program's P-series. The data were analyzed for the entire subject population and were then analyzed by specific age groups, i.e., 17-24, 25-31, 32-38, and 39-45 years of age. This breakdown represents the age ranges in which different physical performance criteria were established for women marines. (*17*)

In an effort to relate the results of this study more directly to the Marine Corps' present concept of overweight for women, height and weight variables were specifically selected to be correlated with relative body fat.

A survey form was completed by each subject that provided information on each individual's menstrual cycle and past history of obesity.

Results and Discussion

The mean values and standard deviations for the anthropometric measurements are presented in Table 2. The coefficients of correlation between each of the anthropometric measures, percent fat, and lean body weight are also given. The mean value for relative body fat in the test group (23.1 percent) is very close to the average of mean values (24.8 percent) reported by Wilmore and Benhnke—25.7 percent, (*26*) Katch and Michael—21.5 percent, (*12*) Jackson and Pollock—24.8 percent, (*8*) and Sloan *et al.*—22.9 percent (*23*) for civilian females of approximately the same age. Military researchers in Canada report 26.8 percent as ideal. (*6*) The Canadian definition of ideal is not known, but it can be safely surmised that in this case, normal is a correct synonym. Unfortunately, either because the military has been so accustomed to using height/weight tables or since all effort has been directed toward preparing men for combat, very little research has been done on the body composition of females in military organizations.

The present value for percent fat appears to be in line with what is considered normal for comparably aged females. The circumference and diameter measurements in Table 2 relate very closely with those reported by Steinkamp. (*24*) The skinfolds, however, are uniformly lower in the Marine data. This is correspondingly reflected in the close percent fat figures of 23.1 percent and 24.8 percent respectively for the Marine and Jackson studies. (*8*)

The results of the stepwise, multiple linear regression analyses are presented in Table 3. It was determined that percent fat is best explained by skinfold measurements with abdominal and thigh skinfolds representing the best predictors. Although wrist diameter appears as a significant predictor of percent fat, its contribution may be spurious due to the fact that it is unrelated to skinfold and circumference measures included in the equation. However, retaining wrist diameter in the equation can be defended on two grounds: 1) the measure has been shown to possess predictive validity by other authors, and 2) its presence in the equation is apparently a correction factor reflecting body frame.

The LBW (Lean Body Weight) formula reflects the major contribution made by dry weight which is logical in that the greatest component of total body weight (TBW) is lean body (LB) mass. It should be noted that percent fat and LBW equations are similar in composition with the exception of thigh skinfold (SF). Items appearing in percent fat equations also are significant predictors for LBW. The equations listed in Table 3 are to be considered as more clinical in nature and should be used when more precise data are needed and hydrostatic weighing is not possible. These clinical equations are justified on two grounds: 1) they possess empirical validity and 2) they possess

*Fat, percentage = (495/Density) - 450

TABLE 3. Multiple Regression Equations for Prediction of Selected Body Composition Variables in Test Group (N=181) and Validation Group (N=45)

Predicted Variable	Variables	Weight	Test Group R	Test Group SE	Validation Group R	Validation Group SE
Fat, %	Abdomen Skinfold	.167	.81	3.50	.75	3.94
Multi-variable	Thigh Skinfold	.162				
S,G,D	Abdomen #2	.217				
	Wrist Diameter	3.380				
	Tricep Skinfold	.274				
	Constant	14.866				
LBW, Kg	Dry Weight	.757	.89	2.11	.90	2.19
Multi-variable	Wrist Diameter	2.742				
S,G,D	Abdomen Circumference #2	.131				
	Tricep Skinfold	.250				
	Abdomen Skinfold	.110				
	Constant	3.816				
Fat, %	Bicep	1.051	.73	4.11	.80	3.81
5-girth	Forearm	-1.522				
	Neck	−0.879				
	Abdomen #2	0.326				
	Thigh	+0.597				
	Constant	0.707				

logical validity. The present study demonstrates that for the Marine population, 66 percent of the variation in percent fat is explained by the variables included in the clinical equation. The equations are logical in that they sample skinfold thickness of the major areas known to serve as fat deposit sites. Within the Marine population, adipose tissue is clearly deposited in the abdominal, thigh, and upper arm region. The remaining variance in percent fat is apparently explained by the presence of random deposits of fat at other minor sites not included in the equation. While other potential sites were sampled, the fact that they failed to enter the equation as predictors implies that these sites do not serve as consistent deposits for adipose tissue among marines or are unreliable to assess.

To determine what regression equation can best be utilized by women marines in a nonclinical environment, the following criteria were considered. The technique must:

- be uncomplicated and easily utilized by the average marine,
- not require the use of complicated or unusually expensive equipment, and
- provide more valid data than the currently used height/weight tables.

Immediately, the use of anthropometers and skinfold calipers are questioned. The relatively high cost* of each instrument and the fact that technicians require concentrated training in order to produce reliable data would seem to lessen the desirability of their use. Girth measurements, on the other hand, require an inexpensive tape measure ($6-23) that is easily maintained, transported, and used. The assumption is made, therefore, that the best prediction equation for Marine Corps use is one that requires only the use of girth measurements.

Statistical analysis revealed that percent fat can be accurately pre-

*1980 prices are $400 for anthropometer and $125 for skinfold caliper

dicted by using the following five-girth equation:

% Fat = 0.707 + (1.051 bicep) - (1.522 x forearm) - (0.879 x neck) + (0.326 x abdomen #2) + (0.597 x thigh) (R = .73, SE - 4.11)

This equation is advocated for use as a nonclinical field test for percent fat of women marines. It clearly meets the first two criteria in that it is simple and inexpensive to use. This nonclinical equation is shown to possess both empirical and logical validity. The measures included explain 53 percent of the variation in percent fat. Additionally, three of the five girth measures, i.e., abdomen, biceps, and thigh, reflect the known major sites for fat deposits mirroring the same sites included in the clinical equations outlined previously. The remaining two measures, i.e., forearm and neck, serve as correction factors for variance in girth measures due to structural differences within the Marine population.

A separate correlation between height/weight and hydrostatically determined percent fat was run in order to establish the reliability of current Marine Corps weight tables. This correlation produced an R = .59 with an SE of 4.81, which is significantly inferior to the proposed girth formula. In other words, a correlation of .59 implies that 35 percent of the variation in percent fat is explained by height/weight, leaving 65 percent unexplained. Clearly, height/weight fails to reflect fat deposits in women.

The regression coefficients obtained in the present study are of approximately the same magnitude as those reported in previous studies. Young (*28*) found a correlation of .72 with an SE of 3.3 percent using six different skinfold sites. Sloan *et al.*, (*23*) Katch and Michael, (*12*) and Wilmore and Behnke (*26*) has .74, .72, and .75 correlations with body density. These investigators used skinfolds or combinations of skinfolds, girths, and diameters.

TABLE 4. Validity Coefficients of Pre-existing Equations Using Women Marine Data

Reference	Measure	Predictor Variables	R	S.E.	Mean
Wilmore & Behnke	Density	Skinfold measures	.71	.0093	1.0621
Wilmore & Behnke	,,	Circumferences and Diameter measures	.69	.0096	1.0653
Katch & Michael	,,	Skinfold & Girth Mean	.71	.0093	1.1240
Sloan et al.	,,	Skinfold	.72	.0092	1.0761
Seltzer et al.	,,	Log triceps skinfold	.70	.0095	1.2261
Parizkova	,,	Log triceps skinfold	.70	.0095	1.1908
Young et al.	,,	Log skinfold mean	.70	.0094	1.0541
Young	,,	Skinfold & Girth Mean	.66	.0099	1.0782
Durnin & Rahaman	,,	Log skinfolds	.69	.0095	1.0841
Nagamine & Suziki	,,	Subscapular Skinfold	.56	.0110	1.0865
Brook	,,	Log Skinfolds	.73	.0089	2.2345
Parizkova	,,	Log Subscapular Skinfold	.59	.0107	1.1168
Young et al.	,,	Anthropometric	.60	.0106	1.0492
Flint et al.	% Fat	Skinfold	.61	4.70	24.68
Flint et al.	,,	Skinfold and Girth	.63	4.60	24.12
Flint et al.	,,	Skinfold and Diameters	.58	4.82	25.13
Jackson & Pollock	,,	Log Skinfolds & Girth	.78	3.71	24.88
Steinkamp et al.	,,	Circumferences	.64	4.62	24.73
Steinkamp et al.	,,	Circumferences/Skinfold	.65	4.60	24.14
Steinkamp et al.	,,	Circumferences/Weight	.66	4.59	24.19
Steinkamp et al.	,,	Weight & Circumferences	.68	4.54	24.56
Steinkamp et al.	,,	Weight & Circumferences/Diameter	.69	4.52	24.50
Steinkamp et al.	,,	Anthropometric	.70	4.50	24.11

Pollock's(*19*) work produced R's using multivariable equations (.78 - .84) that fall in line with the present study's multivariable equation of .78. Steinkamp(*24*) was able to produce simple equations using arm and thigh girths that predicted absolute fat with an R of .91. This is comparable to the correlation found in the multivariable Lean Body Weight formula observed in this study.

In an effort to determine the applicability to the Marine Corps of previously developed equations, 23 anthropometric formulas were compared to the densiometry data obtained on this study's test group. Table 4 compares the R and SE for the original data to that of the present study. As can be seen, none of the previously developed formulas are better than or even equal to the formula of this study. This occurrence clearly established the rule of specificity as being correct. A formula to be used by a specific population must be developed from that population. Age, race, and different degrees of leanness have been listed as partial reasons for the high variability characteristic of female body composition regression equations. Consequently, the Marine equations were tested for lack of fit for various age, race, and leanness groups. In all cases they were found to be unbiased. This can be explained in the case of age and race in that the total sample was fairly homogeneous in these areas with only 10 women over the age of 31 and only one major race subgroup (Negro, N = 44). It was expected, however, that analysis based on percent fat (range 2-37 percent) would show some variance in prediction capability. This did not occur. Also, generalized equations employing polynomial and exponential regression analyses failed to yield nonlinear equations providing significant improvements in estimation for the total group or the various age, race, and leanness groups. This is contrary to the reports of Durnin and Womersley(*3*) and Jackson.(*10*) Table 5 provides multiple correlations and SEs for predicting percent fat based on multiple linear, exponential, and polynomial regression equations. It is interesting to note that the currently available field technique for male marines which employs total body weight and abdomen #2 measures has a relatively poor prediction capability for women but still is better than the women's height/weight table.

TABLE 5. Multiple Correlations and Standard Errors of Estimates for Predicting Percent Fat Based on Multiple Linear, Exponential, and Polynomial Regression Equations

Variables	R	S.E.
11 Best All Variables, Linear	.85	3.13
Best All Variables, Exponential	.86	3.03
3 Best Skinfolds	.77	3.79
2 Best Skinfolds, Exponential	.77	3.79
3 Best Skinfolds, Exponential	.78	3.83
4 Best Skinfolds, Exponential	.78	3.83
9 Sum of Skinfolds, Polynomial	.78	3.83
4 Best Girths and Weight, Linear	.72	4.12
5 Best Girths and Weight, Linear	.73	4.06
8 Best Girths and Weight, Linear	.78	3.83
5 Best Girths	.73	4.11
Height and Weight	.59	4.81
Weight and Abdomen 2	.62	4.68

Previous investigators have eluded to the menstrual cycle as an extraneous factor influencing body composition components but have failed to address its significance in their estimation process. To investigate the effect of fluid retention on body composition, measures reflecting menstrual cycle and oral contraceptives were forced into this study's predictive equation. To evaluate the effects of the menstrual cycle, the subjects were divided into two groups: those who were within seven days $\pm$ of the beginning of their period and those who were outside this zone. Analysis did not reveal a significant difference between these groups. Individuals utilizing oral contraceptives, however, were found to consistently have their percent fat overestimated by 0.8 percent.

Before a formula developed for use by a specific population can be said to be valid, it must be checked through a sample of the population which is independent of the test group.(*4*) Table 3 gives the validation coefficients of the recommended five-girth regression equation as well as the multivariable clinical equations for percent fat and LBW. Applications of all three equations on the independent test

FIGURE 3. Neck Girth

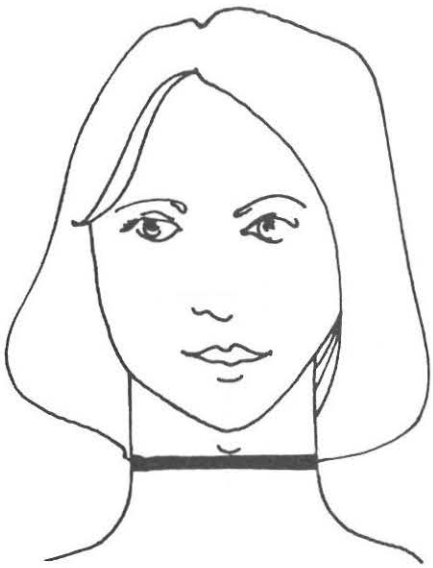


FIGURE 5. Arm and Forearm Girth

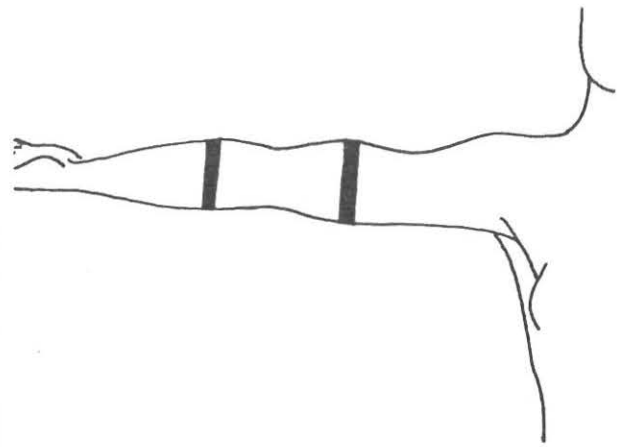


FIGURE 4. Abdomen #2 Girth

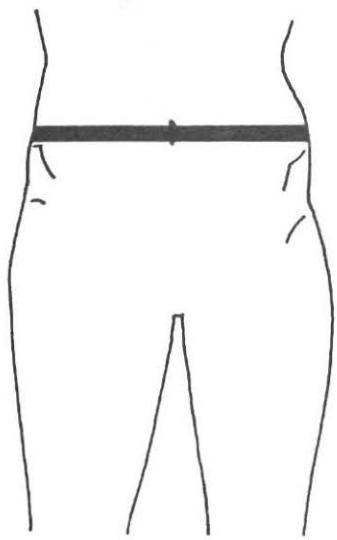
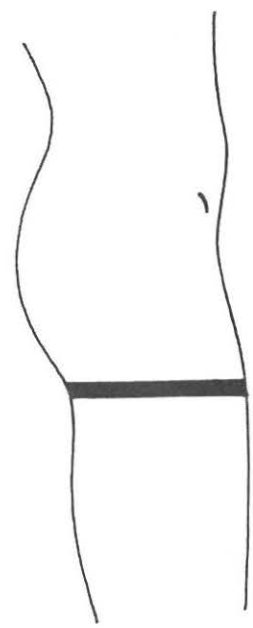


FIGURE 6. Thigh Girth



FIVE-GIRTH PERCENT FAT PE

PTS	Bicep	Forearm	Neck	Abdomen	Thigh	PTS	Bicep	Forearm	Neck	Abdomen	Thigh	PTS	Bicep	Forearm	Neck	Abdomen	Thigh
.0				17 5/8	11 6/8	7.2				26 3/8		14.4	11		9 2/8	35 0/8	
.1	5 7/8		15 5/8	17 6/8		7.3				26 4/8	16 4/8	14.5	11 2/8			35 1/8	21 2/8
.2		17 5/8		17 7/8	11 7/8	7.4	8 5/8	15 6/8	12 3/8	26 5/8	16 5/8	14.6		13 7/8		35 2/8	21 3/8
.3				18 0/8		7.5				26 6/8		14.7			9 1/8	35 3/8	
.4	6 0/8		15 4/8	18 1/8	12 0/8	7.6				26 7/8	16 6/8	14.8	11 3/8			35 4/8	21 4/8
.5				18 2/8		7.7			12 2/8	27 0/8		14.9			9 0/8	35 5/8	
.6		17 4/8		18 3/8	12 1/8	7.8	8 6/8			27 1/8	16 7/8	15.0				35 6/8	21 5/8
.7			15 3/8	18 4/8		7.9		15 5/8		27 2/8		15.1	11 4/8	13 6/8		35 7/8	
.8	6 1/8			18 5/8	12 2/8	8.0			12 1/8		17 0/8	15.2			8 7/8	36 0/8	21 6/8
.9				18 6/8		8.1	8 7/8			27 3/8		15.3				36 1/8	
1.0			15 2/8	18 7/8	12 3/8	8.2			12 0/8	27 4/8	17 1/8	15.4				36 2/8	21 7/8
1.1	6 2/8	17 3/8		19 0/8		8.3		15 4/8		27 5/8		15.5	11 5/8		8 6/8	36 3/8	
1.2				19 1/8	12 4/8	8.4	9 0/8			27 6/8	17 2/8	15.6		13 5/8		36 4/8	22 0/8
1.3			15 1/8	19 2/8		8.5			11 7/8	27 7/8		15.7				36 5/8	
1.4	6 3/8			19 3/8	12 5/8	8.6				28 0/8	17 3/8	15.8	11 6/8		8 5/8	36 6/8	22 1/8
1.5			15 0/8	19 4/8		8.7				28 1/8		15.9				36 7/8	
1.6		17 2/8		19 5/8	12 6/8	8.8	9 1/8	15 3/8	11 6/8	28 2/8	17 4/8	16.0				37 0/8	22 2/8
1.7				19 6/8		8.9				28 3/8		16.1	11 7/8	13 4/8	8 4/8	37 1/8	
1.8	6 4/8		14 7/8	19 7/8	12 7/8	9.0				28 4/8	17 5/8	16.2				37 2/8	22 3/8
1.9				20 0/8	13 0/8	9.1	9 2/8		11 5/8	28 5/8	17 6/8	16.3			8 3/8	37 3/8	22 4/8
2.0				20 1/8		9.2				28 6/8		16.4				37 4/8	
2.1	6 5/8	17 1/8	14 6/8		13 1/8	9.3		15 2/8		28 7/8	17 7/8	16.5	12 0/8			37 5/8	22 5/8
2.2				20 2/8		9.4	9 3/8		11 4/8	29 0/8		16.6		13 3/8		37 6/8	
2.3				20 3/8	13 2/8	9.5				29 1/8	18 0/8	16.7			8 2/8	37 7/8	22 6/8
2.4	6 6/8		14 5/8	20 4/8		9.6			11 3/8	29 2/8		16.8	12 1/8			38 0/8	
2.5		17 0/8		20 5/8	13 3/8	9.7				29 3/8	18 1/8	16.9			8 1/8		22 7/8
2.6				20 6/8		9.8	9 4/8	15 1/8		29 4/8		17.0		13 2/8		38 1/8	
2.7			14 4/8	20 7/8	13 4/8	9.9			11 2/8	29 5/8	18 2/8	17.1	12 2/8			38 2/8	23 0/8
2.8	6 7/8			21 0/8		10.0				29 6/8		17.2			8 0/8	38 3/8	
2.9			14 3/8	21 1/8	13 5/8	10.1	9 5/8			29 7/8	18 3/8	17.3				38 4/8	23 1/8
3.0		16 7/8		21 2/8		10.2			11 1/8	30 0/8		17.4			7 7/8	38 5/8	
3.1	7 0/8			21 3/8	13 6/8	10.3		15 0/8		30 1/8	18 4/8	17.5	12 3/8	13 1/8		38 6/8	23 2/8
3.2			14 2/8	21 4/8		10.4	9 6/8			30 2/8		17.6				38 7/8	
3.3				21 5/8	13 7/8	10.5				30 3/8	18 5/8	17.7			7 6/8	39 0/8	23 3/8
3.4	7 1/8			21 6/8		10.6			11 0/8	30 4/8		17.8	12 4/8			39 1/8	
3.5		16 6/8	14 1/8	21 7/8	14 0/8	10.7				30 5/8	18 6/8	17.9				39 2/8	23 4/8
3.6				22 0/8	14 1/8	10.8	9 7/8	14 7/8	10 7/8	30 6/8		18.0		13 0/8	7 5/8	39 3/8	
3.7				22 1/8		10.9				30 7/8	18 7/8	18.1	12 5/8			39 4/8	23 5/8
3.8	7 2/8		14 0/8	22 2/8	14 2/8	11.0			10 6/8		19 0/8	18.2				39 5/8	23 6/8
3.9				22 3/8		11.1	10 0/8			31 0/8		18.3			7 4/8	39 6/8	
4.0		16 5/8		22 4/8	14 3/8	11.2		14 6/8		31 1/8	19 1/8	18.4				39 7/8	23 7/8
4.1	7 3/8		13 7/8	22 5/8		11.3			10 5/8	31 2/8		18.5	12 6/8	12 7/8		40 0/8	
4.2				22 6/8	14 4/8	11.4	10 1/8			31 3/8	19 2/8	18.6			7 3/8	40 1/8	24 0/8
4.3			13 6/8	22 7/8		11.5				31 4/8		18.7				40 2/8	
4.4	7 4/8			23 0/8	14 5/8	11.6			10 4/8	31 5/8	19 3/8	18.8	12 7/8			40 3/8	24 1/8
4.5		16 4/8		23 1/8		11.7		14 5/8		31 6/8		18.9				40 4/8	
4.6			13 5/8	23 2/8	14 6/8	11.8	10 2/8			31 7/8	19 4/8	19.0		12 6/8		40 5/8	24 2/8
4.7				23 3/8		11.9			10 3/8	32 0/8		19.1	13 0/8			40 6/8	
4.8	7 5/8			23 4/8	14 7/8	12.0				32 1/8	19 5/8	19.2				40 7/8	24 3/8
4.9			13 4/8	23 5/8		12.1	10 3/8		10 2/8	32 2/8		19.3				41 0/8	
5.0		16 3/8		23 6/8	15 0/8	12.2		14 4/8		32 3/8	19 6/8	19.4				41 1/8	24 4/8
5.1	7 6/8					12.3				32 4/8		19.5	13 1/8	12 5/8		41 2/8	
5.2			13 3/8	23 7/8	15 1/8	12.4	10 4/8		10 1/8	32 5/8	19 7/8	19.6				41 3/8	24 5/8
5.3				24 0/8		12.5				32 6/8		19.7				41 4/8	
5.4	7 7/8	16 2/8	13 2/8	24 1/8	15 2/8	12.6				32 7/8	20 0/8	19.8	13 2/8				24 6/8
5.5				24 2/8	15 3/8	12.7		14 3/8	10 0/8	33 0/8	20 1/8	19.9		12 4/8		41 5/8	
5.6				24 3/8		12.8	10 5/8			33 1/8		20.0				41 6/8	24 7/8
5.7			13 1/8	24 4/8	15 4/8	12.9				33 2/8	20 2/8	20.1	13 3/8			41 7/8	25 0/8
5.8	8 0/8			24 5/8		13.0			9 7/8	33 3/8		20.2				42 0/8	
5.9		16 1/8		24 6/8	15 5/8	13.1	10 6/8			33 4/8	20 3/8	20.3				42 1/8	25 1/8
6.0			13 0/8	24 7/8		13.2		14 2/8		33 5/8		20.4		12 3/8		42 2/8	
6.1	8 1/8			25 0/8	15 6/8	13.3			9 6/8	33 6/8	20 4/8	20.5	13 4/8			42 3/8	25 2/8
6.2				25 1/8		13.4				33 7/8		20.6				42 4/8	
6.3			12 7/8	25 2/8	15 7/8	13.5	10 7/8		9 5/8	34 0/8	20 5/8	20.7				42 5/8	25 3/8
6.4	8 2/8	16 0/8		25 3/8		13.6				34 1/8		20.8	13 5/8			42 6/8	
6.5				25 4/8	16 0/8	13.7		14 1/8		34 2/8	20 6/8	20.9		12 2/8		42 7/8	25 4/8
6.6			12 6/8	25 5/8		13.8	11 0/8		9 4/8	34 3/8		21.0				43 0/8	
6.7				25 6/8	16 1/8	13.9					20 7/8	21.1	13 6/8			43 1/8	25 5/8
6.8	8 3/8		12 5/8	25 7/8		14.0				34 4/8		21.2				43 2/8	
6.9		15 7/8		26 0/8	16 2/8	14.1	11 1/8	14 0/8	9 3/8	34 5/8	21 0/8	21.3				43 3/8	25 6/8
7.0				26 1/8		14.2				34 6/8		21.4		12 1/8		43 4/8	
7.1	8 4/8		12 4/8	26 2/8	16 3/8	14.3				34.7/8	21 1/8	21.5				43 5/8	25 7/8

*Sum points derived for each measurement. Subtract 54.598 from total points to obtain percent fat.

LE 6

DICTION TABLES FOR WOMEN

PTS	Bicep	Forearm	Neck	Abdomen	Thigh
21.6		12 1/8		43 6/8	
21.7				43 7/8	26 0/8
21.8				44 0/8	26 1/8
21.9		12 0/8		44 1/8	
22.0				44 2/8	26 2/8
22.1				44 3/8	
22.2				44 4/8	26 3/8
22.3		11 7/8		44 5/8	
22.4				44 6/8	26 4/8
22.5				44 7/8	
22.6				45 0/8	26 5/8
22.7				45 1/8	
22.8		11 6/8			26 6/8
22.9				45 2/8	
23.0				45 3/8	26 7/8
23.1				45 4/8	
23.2				45 5/8	27 0/8
23.3		11 5/8		45 6/8	
23.4				45 7/8	27 1/8
23.5				46 0/8	
23.6				46 1/8	27 2/8
23.7				46 2/8	27 3/8
23.8		11 4/8		46 3/8	
23.9				46 4/8	27 4/8
24.0				46 5/8	
24.1				46 6/8	27 5/8
24.2				46 7/8	
24.3		11 3/8		47 0/8	27 6/8
24.4				47 1/8	
24.5				47 2/8	27 7/8
24.6				47 3/8	
24.7				47 4/8	28 0/8
24.8				47 5/8	
24.9		11 2/8		47 6/8	28 1/8
25.0				47 7/8	
25.1				48 0/8	28 2/8
25.2		11 1/8		48 1/8	
25.3				48 2/8	28 3/8
25.4				48 3/8	28 4/8
25.5				48 4/8	
25.6				48 5/8	28 5/8
25.7		11 0/8			
25.8				48 6/8	28 6/8
25.9				48 7/8	
26.0				49 0/8	28 7/8
26.1				49 1/8	
26.2		10 7/8			29 0/8
26.3					
26.4					29 1/8
26.5					
26.6					29 2/8
26.7		10 6/8			
26.8					29 3/8
26.9					
27.0					29 4/8
27.1					
27.2		10 5/8			29 5/8
27.3					29 6/8
27.4					
27.5					29 7/8
27.6					
27.7		10 4/8			30 0/8
27.8					
27.9					30 1/8
28.0					
28.1		10 3/8			30 2/8
28.2					
28.3					30 3/8
28.4					
28.5		10 2/8			30 4/8

PTS	Bicep	Forearm	Neck	Abdomen	Thigh
28.8					
28.9					30 6/8
29.0					30 7/8
29.1		10 1/8			
29.2					31 0/8
29.3					
29.4					31 1/8
29.5					
29.6		10 0/8			31 2/8
29.7					
29.8					31 3/8
29.9					
30.0					31 4/8
30.1		9 7/8			
30.2					31 5/8
30.3					
30.4					31 6/8
30.5					
30.6		9 6/8			31 7/8
30.7					
30.8					32 0/8
30.9					32 1/8
31.0		9 5/8			
31.1					32 2/8
31.2					
31.3					32 3/8
31.4					
31.5		9 4/8			32 4/8
31.6					
31.7					32 5/8
31.8					
31.9					32 6/8
32.0		9 3/8			
32.1					32 7/8
32.2					
32.3					33 0/8
32.4					
32.5		9 2/8			33 1/8
32.6					
32.7					33 2/8
32.8					33 3/8
32.9					33 4/8
33.0		9 1/8			
33.1					
33.2					
33.3					
33.4					
33.5		9 0/8			
33.6					
33.7					
33.8					
33.9		8 7/8			
34.0					
34.1					
34.2					
34.3					
34.4		8 6/8			
34.5					
34.6					
34.7					
34.8					
34.9		8 5/8			
35.0					
35.1					
35.2					
35.3					
35.4		8 4/8			
35.5					
35.6					
35.7					

PTS	Bicep	Forearm	Neck	Abdomen	Thigh
36.0		8 3/8			
36.1					
36.2					
36.3					
36.4		8 2/8			
36.5					
36.6					
36.7					
36.8		8 1/8			
36.9					
37.0					
37.1					
37.2					
37.3		8 0/8			
37.4					
37.5					
37.6					
37.7					
37.8		7 7/8			
37.9					
38.0					
38.1					
38.2					
38.3		7 6/8			
38.4					
38.5					
38.6					
38.7					
38.8		7 5/8			
38.9					
39.0					
39.1					
39.2					
39.3		7 4/8			
39.4					
39.5					
39.6					
39.7		7 3/8			
39.8					
39.9					
40.0					
40.1					
40.2		7 2/8			
40.3					
40.4					
40.5					
40.6					
40.7		7 1/8			
40.8					
40.9					
41.0					
41.1					
41.2		7 0/8			
41.3					
41.4					
41.5					
41.6					
41.7		6 7/8			
41.8					
41.9					
42.0					
42.1					
42.2		6 6/8			
42.3					
42.4					
42.5		6 5/8			
42.6					
.0					
.0		0 0/8			
.0					

group of randomly selected women marines yield multiple correlations compatible with those of the original test group. Therefore, it can be stated that the equations are valid for use by women marines.

Conclusions

The present study has shown that the traditional method of estimating women marines' best weight through height/weight tables is as unacceptable as previously determined for male marines. (*27*) Both clinical and nonclinical prediction equations have been developed that provide superior information as to the percent fat component of women marines. The nonclinical, all-girth measurement equation developed through this study has been shown to be a valid measure of percent body fat and independent of age, body frame size, race, and the cyclic characteristics of the menstrual cycle.

Figures 3-6 show the technique for taking the five-girth measures. In order to provide an easily used assessment tool, the five-girth percent fat equation has been transformed to a table as shown in Table 6. A marine need only find her specific measurement in each of the girth columns. The point columns in Table 6 represent fat percentage points. Simply sum the points representing each girth measurement, subtract the correction factor (54.598), and the subtrahend represents total percent fat. In order to determine ideal body weight (IBW), first ascertain total nude body weight (TBW). Second, multiply TBW x percent fat, and divide the result by 100 to obtain absolute or total body fat (TBF). Next subtract TBF from TBW to obtain lean body weight (LBW). Ideal body weight at an ideal value for percent fat = LBW/(1.000 - ideal value for percent fat).

As an example:

TBW = 125 lb
% Fat = 28%
TBF = 125 x .28 = 35 lb
LBW = 125 lb - 35 lb = 90 lb
Ideal value for % fat = 18%
IBW = 90 lb/(1.000 - .18)
IBW = 90 lb/.82 = 110
IBW = 110 lb

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Navy and Marine Corps Members and Families: An Advocacy Position

LT Serge R. Doucette, Jr., MSC, USN

The military today, is not the military as it was known in past generations. The complex social changes that have affected the United States and the world, have also been reflected in the military community. It has become increasingly clear that this apparently obvious statement must be made, for many individuals still view the Navy and Marine Corps as it was over 30 years ago.

In the past, we were largely comprised of single male service members. World War II and after saw an increase in the numbers of married people, but they remained a relatively small percentage of the active duty force. Married service members lived predominately on military reservations or commands. Exchanges, commissaries, gas stations, and on-base housing created communities essentially isolated from the surrounding civilian communities.

Table 1 presents some of the significant considerations affecting today's Navy. Even a cursory review of Table 1 reveals that these are but a few of the many significant factors that have emerged over the past 30 years. However, one major impact of all these changes is clear; today the service member/family is less isolated from, and is in fact, an integral part of the civilian community.

These changes have necessitated a revision in our basic policies and management systems as they apply to our overall mission, the defense of our country. It is a shared responsibility, military and civilian, to update our service delivery systems in order to continue in the development of human potential and the meeting of basic needs.

Currently, there are many diverse efforts in the involvement with families. We must strive to pull together all these efforts and examine our values and commitments. In order to effect change, we need to agree upon what is to change, and the methods that will be employed.

At this time, there is no universally accepted definition of family. We are still in the process of defining equality. We are in a constant struggle between personal, family, and social rights.

TABLE 1. Significant Considerations

- Today's Navy has more women.
- Forty-three percent of the officers and enlisted personnel are married, and the percentage increases to 75 percent for service members with four or more years of Navy experience.
- Approximately a half million men and women are now on active Navy duty.
- There are approximately 600,000 primary dependents.
- Traditional male duties are being assumed by qualified women.
- There is clear evidence that reenlistment decisions and hence personnel and operational readiness are greatly influenced by spouse and family considerations.
- More and more families and single service members live within the civilian community rather than on base.
- Inflation and economic setbacks have affected the services provided to our service members and their families. For example, today, many dependents must be "referred out" for medical treatment.
- Abuse, neglect, sexual assault, and rape cross socioeconomic boundaries and military hierarchies.
- Unmarried and single parent service members are considered to be a part of an extended Navy family, requiring the same concern and support as married service members and their dependents who comprise the more traditional view of family.

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Violence appears to be a common thread woven through our discussions of families. We are increasing our awareness and efforts in the areas of spouse abuse, child abuse, sexual assault and rape, and yet the gate receipts from a single football game can total more than an entire community's efforts in these areas.

Our combined mission should be to improve the awareness of, and access to, reliable and useful information, resources, and services that support and enrich the lives of the American people. The Surgeon General of the Navy, VADM Willard P. Arentzen, summed it up in his statement, "We must continually strive for the preservation and promotion of our most important 'Natural Resource'—People."

Throughout our history, there have been numerous informal and formal programs designed to meet the needs of Navy and Marine Corps members and families.

Currently, we are coordinating and furthering the development of the medical care delivery system, the family advocacy program, the substance abuse program, the mental health program, and the Navy and Marine Corps family service program.

In our efforts to meet our mission, we have established the following objectives:

- Increase effective coordination and use of existing military and civilian resources.
- Identify any additional resources that may be required at the local or national level.
- Assist in the foundation/establishment of effective prevention, intervention, and treatment programs at the local and national level.
- Assist in the development of national awareness and standards applicable to the full development of human potential.
- Assist in obtaining necessary fiscal and staffing support for critical human support programs and services.

In order to meet these objectives, we have formulated the interagency program goals presented in Table 2. As this table shows, the Family Advocacy Program is only one part of an overall, comprehensive effort at improving Navy and Marine Corps life. Although only one of many efforts, the Family Advocacy Program is viewed as having a direct and significant impact upon the quality of military life and is important to a viable defense position. The remainder of this paper is a brief overview of the Family Advocacy Program.

The State of the Program

The goal of the Family Advocacy Program is to respond to child abuse and neglect, spouse abuse and neglect, and sexual assault and rape incidents (domestic violence) among Navy and Marine Corps families, and to initiate educational and other primary prevention measures for all Navy and Marine Corps members and families.

Domestic violence, like alcohol abuse, is a severe form of family dysfunction that transcends the boundaries of the family unit. In each incident, there is a degree of loss of health, money, time, and talents. These losses extend beyond the individual to include the family, society, and work environments. Each incident is a drain on our hos-

TABLE 2. Interagency Program Goals

- Establish network of Family Service Centers.
- Expand efforts of the Family Advocacy Program in prevention, identification, intervention, and treatment of victims and perpetrators of abuse, neglect, sexual assault, and rape.
- Expand efforts of Substance Abuse Program in areas of prevention, identification, intervention, and treatment of all forms of substance abuse, such as alcohol, drugs, and overeating.
- Expand efforts of Navy Mental Health Program.
- Provide for increased accessibility of medical care of our beneficiaries.
- Provide training, technical assistance, positive support, and guidance to military commands and their civilian communities desiring to develop or improve their own family support programs.
- Develop awareness programs emphasizing the importance of individual and family needs to the Navy's mission.
- Conduct research and studies that document and guide future military and civilian efforts and policy.
- Foster and promote formation of an overall Department of Defense coordinated effort.
- Foster and promote formation of a Military Resource Center acting similarly to existing civilian national centers.

pitals, administrative personnel, legal systems, and military readiness capability.

Current estimates indicate that reported incidents reflect only 10 percent of the actual amount of domestic violence. In 1978, 907 child abuse reports were received from Navy and Marine Corps activities. Yet, in one California county, research in the Department of Public Welfare shows that military families comprise 30 percent of the population and about one-third of all reported child abuse cases. This represents over 2,000 military cases of child abuse in this county alone for 1978.

When viewed as a cost factor, these figures represent a staggering drain on current resources, mission effectiveness, and retention. Medical, Naval Investigation Service, and Judge Advocate General investigation reports document this extensive negative impact.

We currently have severe personnel shortages in almost all areas. Retention of personnel is directly affected by domestic violence acts. In some cases, a felony is committed resulting in costly, time-consuming action which can lead to prosecution, incarceration, and inevitable discharge. This is preventable, for virtually all these acts are explosive, emotional stress responses that are avoidable through early intervention. However, fear of detection and prosecution often causes many families not to seek treatment or to turn to civilian agencies for treatment and support. This requires substantial family financial outlay, even with CHAMPUS, and it increases family burdens and often results in a compounding of existing family stress.

We must demonstrate to our military members and families that we recognize and care about their problems and we have the ability to provide support and assistance necessary to reestablish adequate health and functioning.

Research has shown that only 25 percent of Navy spouses think that the Navy cares about the family or takes care of its own. Medical benefits are cited as a major reason for joining the service, but are also listed as a major reason for leaving the service. Spouses have a major influence on the retention of the active duty member. The spouse will certainly not support staying in the service if the military is viewed as the source of the families' problems.

Family advocacy is a health promotion and treatment system designed to counter current negative trends. By FY81, funding will allow for 20 social workers and an equal amount of support personnel to support 27 major BUMED activities, as well as all clinics regionalized under them. A base of two social workers and one clerk-typist is necessary at each major facility for the functioning of the program at an extreme minimum level. The FY82 budget is currently being prepared to reflect the balance of our needs.

The manpower recommendations of social workers and clerical support at BUMED-sponsored facilities may seem puzzling in light of the tremendous variation in size and workload among these facilities. There are several reasons why the recommendations are as described.

The goal of this program is not to solve all local problems in the area of abuse and neglect, but rather to provide each facility with the administrative assistance and basic resources to launch an effective program. Locally determined needs and priorities will then define additional requirements.

Every facility which serves a significant dependent population needs at least two social workers (with a clerical assistant) to coordinate the Family Advocacy Program in that community. The location (remote *vs.* urban) and nature (Marine Corps base *vs.* Naval Air Facility) of the community, as well as its size, will determine additional needs.

The quality as well as the quantity of required personnel depends on the community being served. At a CONUS regional center, two energetic social workers might suffice whereas, overseas facilities require unique services and additional support.

Family advocacy involves more than recognition, reporting, and acute care of incidents. Preventive and health promotional measures are equally important. Such programs as parent effectiveness training, expectant mothers counseling, and Parents Anonymous chapters are essential and would have to be supported "in house" at many of our smaller and more remote facilities.

In summary, the goal of this program is to provide the nucleus personnel who, with command cooperation and BUMED guidance, will be in the best position to define and request those additional resources needed to develop an effective local Family Advocacy Program. The Central Committee for Family Advocacy is well aware of the need for clarity regarding the impact of new social workers from this program upon other current budget proposals for social workers. The request for social workers in the Family Advocacy Program involves recruiting civilian social workers, and the utilization of uniformed social workers.

Military and civilian communities have, over a period of time, been active in the development of programs relevant to Family Advocacy. Currently, there are an unknown number of these efforts throughout the world. In many instances, program locations, capabilities, and

methods are not known or shared with the various agencies affecting the same general population. Among other effects, this can result in either duplication of resources and efforts or result in a lack of referring individuals/families to "unknown" adjunctive services.

Interagency cooperation and support is a mandate in order to provide timely and adequate intervention to individuals and families in need. Military individuals and families are very mobile, crossing many county, state, and international boundaries. A worldwide program network necessitates a full understanding and cooperation with a multitude of available resources. An effective community effort can only result from a combination of all available individual efforts. It is a shared responsibility, military and civilian, to implement programs which are flexible and responsive to local community needs and available resources.

Need for coordination is also based upon the basic premise that the problems of child abuse/neglect, spouse abuse/neglect, and sexual assault and rape are multicausal in nature, interactionary, and require multidisciplinary solutions and multiagency service delivery systems.

Coordination is not a program or activity in itself. Coordination is a condition for establishing programs, carrying out activities in such a way that efforts to attain common goals are not duplicated; that resources are efficiently and productively used; and that all aspects of the prevention and treatment of child abuse/neglect, spouse abuse/neglect, and sexual assault and rape are addressed.

It is our sincere hope that we can all move toward the common goal of "The preservation and promotion of our most important 'Natural Resource'—People." □

Four New Medical Centers To Open This Year

James R. Brassfield

This year will be a first in the annals of the Navy Medical Department in terms of facilities acquisition. Four new major medical centers are scheduled to begin operation before the year has ended. Bremerton, Yokosuka, Orlando, and Bethesda are all expected to open new doors to patients.

Bremerton

In Bremerton, WA, last January, the Government accepted the replacement NRMC facility. Located just north of the Jackson Park housing area, it is sited on beautiful, naturally wooded acreage overlooking Ostrich Bay. The building has been designed to compliment the surrounding landscape and to bring the outdoors inside to create warmth in the hospital environment reflective of the northwest. The use of wood as a finish material in waiting spaces and corridors is intended to recall the forest surrounding the building and reduce the feeling of an institutional structure.

In addition to the attention to finish materials, waiting spaces were strategically separated to allow for patient privacy and located to permit outside views. The patient has a choice of the forest, the bay, the Olympic Mountains to the west, or the Cascade Range to the east, including Mt. Rainier.

As an additional touch to the exterior of the hospital, the Navy hired the services of a sculptor to fabricate forms for precast concrete panels for the elevator towers. The symbols formed within these panels are duplications of images used by the Haida Indians, a tribe indigenous to the great Northwest.

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Naval Regional Medical Center Bremerton, WA.

Naval Regional Medical Center Yokosuka, Japan.

The architectural/engineering joint venture responsible for the Bremerton design was John Graham and Company of Seattle, WA and Sherlock, Smith, and Adams, Inc. of Montgomery, AL. The building contractor was Santa Fe Engineers, Inc. of Lancaster, CA.

Yokosuka

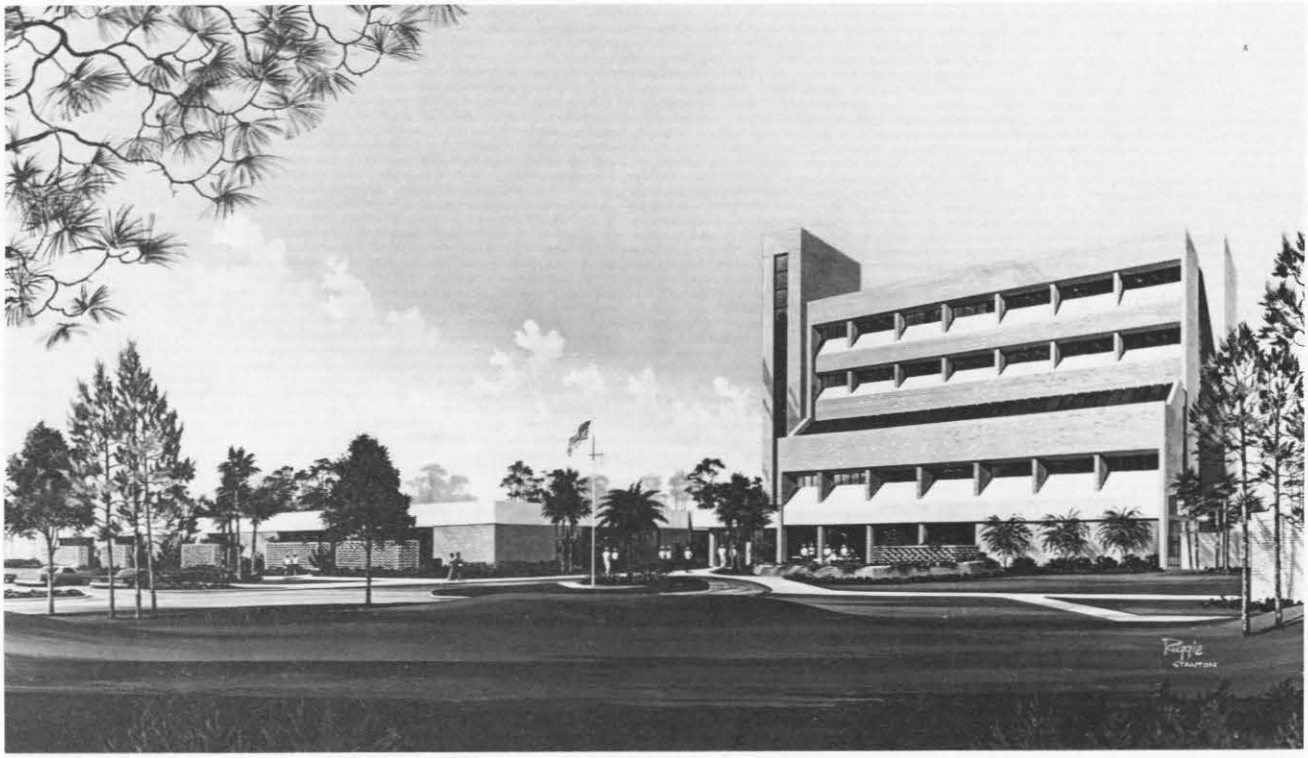
Across the Pacific from Seattle, the replacement NRMC Yokosuka is scheduled to begin operation in August. This project was initiated as a result of a quid pro quo agreement between the U.S. Government and the Government of Japan. For return by the U.S. to Japan of real estate occupied by American forces for the past 30 years, the Japanese agreed to replace outmoded U.S. facilities with new construction.

Ordinarily, projects of this scope require that the U.S. Government contract with private architectural/engineering firms to complete concept and final design services. However, due to its unique aspects, the concept development occurred outside the normal military construction process and was accomplished by BUMED and Naval Facilities Engineering Command personnel. The medical programming and planning were developed by the author and the project architects were Ronald Johnson and Donald Crigler of the Naval Facilities Engineering Command. The final working drawings and specifications were completed by the Japanese firm of Nihon Architects, Engineers & Consultants, Inc. of Tokyo.

This new facility of 135 beds includes the first Navy application of the triangular nursing unit design. This concept is intended to achieve a compact nursing floor configuration and to reduce travel distances from the nurse stations to bedrooms, thereby increasing the efficiency of the staff. The design and orientation of the nursing units, in the case of Yokosuka, also allows for the future application of solar energy collectors on the south wall of the structure.

Orlando

The application of solar energy systems is currently being incorporated into the construction of the new NRMC Orlando. This system will provide total hot water heating, space heating, and up to 100 tons of cooling (approximately 20 percent of the total requirement) with solar energy. The system selected will consist of 1,500 square feet of flat plate collectors for hot water and space heating, and 8,500 square feet of flat plate collectors with reflectors for cooling. The flat plate collectors are integrated into the



Naval Regional Medical Center Orlando, FL.

architectural design of the building. The cost of the solar system is approximately two percent of the total building cost. The fuel oil savings are estimated to be 600,000 to 1,000,000 gallons over 50 years.

Until recently, the low cost for energy derived from fossil fuels has suppressed the development of solar energy systems; however, with the ever rising cost and the diminishing supply of fossil fuels, this country is finally turning to solar energy. BUMED and the Naval Facilities Engineering Command feel that the solar energy system being constructed for NRMC Orlando, is a small, but necessary step to take in the utilization of solar energy systems. The documentation of this system will provide a data base for improving the efficiency of future solar energy systems and hopefully go a long way toward advancing current solar energy technology.

The new medical center at Orlando will provide 104 beds, outpatient clinics, and ancillary functions within 204,500 square feet. The architectural/engineering firm which prepared the design was a joint venture consisting of Rogers, Lovelock, and Fritz, Winter Park, FL; Rogers and Butler, New York City; Lopatka and McQuaig, Winter Park, FL; and the Wall Corporation, Washington, DC. The solar energy consultant was Peter Flack of the Firm Flack and Kurtz, New York, NY. The building contractor was the Frank Briscoe Company of East Orange, NJ.

In addition to the main hospital building, a medical support building has been constructed at a scope of 15,000 square feet containing storage and office space to aid during the relocation from the old to the new hospital and to serve as the regional medical supply center at the completion of construction of the new facilities.

At the completion of the new medical center, the remaining World War II cantonment structures will be demolished, leaving the new building on an imposing site overlooking Lake Baldwin. It is anticipated that the new facilities will provide a long-needed improvement at NRMC Orlando, and will be of great benefit in serving the Navy health care needs of the Orlando area for many years to come.

Bethesda

Finally, at NNMC Bethesda, MD, the new 500-bed replacement hospital is nearing completion with occupancy scheduled for late fall. This facility includes the most sophisticated, modern, state-of-the-art features of medical facility design, including flexibility and expandability. The basic long-span structural system design is intended to accommodate changes in interior space utilization. As requirements in medical practice change, it is expected that physical spaces can

National Naval Medical Center Bethesda, MD.

be adjusted to meet the new functional needs.

An automated material handling system has been incorporated into the hospital to move supplies, material, and food to the patients, which should greatly increase staff efficiency and provide for better service to both inpatients and outpatients.

Access to the Bethesda complex should be greatly improved with the utilization of two new parking structures, one of which is connected directly to the new outpatient clinic and nursing tower by enclosed pedestrian bridges. The second parking structure is intended primarily for staff and relates to the existing complex which is to be rehabilitated, in part, for staff facilities.

The design of the new outpatient clinic building is highlighted by the co-location of related clinics to optimize staff requirements and reduce walking distances for patients in this large building. Also, for ease of orientation, the clinics have been planned around large mall spaces, similar to a shopping center, so that patients can easily relate to the various departments and reduce any possibility of confusion.

The intensive care elements have, of course, been designed to the highest order of technical advancement in surgery, coronary care, obstetrics, nursery, and other related areas.

The design of the new NNMC complex was accomplished by Ellerbe Associates, Inc. of Bloomington, MN, and Dalton, Dalton, and Newport of Cleveland, OH. The Blake Construction Company of Washington, DC is the builder.

The Near Future

The four new medical centers mentioned in this article represent the largest number of completed hospital projects experienced in one year by BUMED. However, the job is not over. A replacement hospital is currently under construction at Camp Lejeune, NC, and several small clinics are also being completed. On the drawing board is the final phase of the Bethesda retrofit project which will complete the NNMC complex. On the horizon is the largest Navy hospital project ever—the medical center replacement at San Diego estimated at $293 million. This design is scheduled for completion this January with construction anticipated to begin in the summer of 1981.

In addition to these efforts, the Facilities Division has developed a five-year plan which proposes correction of approximately two-thirds of the known backlog of deficiencies. Please stick around. Pending the economic vagaries of the future, the Facilities Division will eventually get around to your activity! □

EMT Training at Okinawa

"Mack, on the count of three we're going to move you, Okay?" asked a pleasant, soft-spoken feminine voice. "One, two, three," she counted and slowly moved Mack back against the car seat.

"Aaaaaaaaaugh!" screamed Mack. "It hurts, what's wrong with me?" he cried, choking back tears.

"You're going to be fine," she whispered, soothingly. "We'll have you out of here in just a minute and on the way to the hospital."

Look out Jane Fonda and John Voight, for the next Oscar winners could just as easily be HM3 Cherie Kildow, and LCPL Brian McLaughlin of Camp S.D. Butler, both students attending the Emergency Medical Technician program at NRMC Okinawa.

The scene described occurred at the Zukeran impound lot. Fourteen Navy students including one marine ambulance driver received lessons on how to safely remove victims of a car crash. With just a screwdriver, Navy LT Marvin Trowbridge, the class instructor, showed students how to remove a windshield.

"The idea is to remove the windshield carefully, so as not to shatter the glass and create further injuries," he said. Ten minutes later, with the help of another student, Trowbridge successfully removed the windshield to everyone's amazement.

The next lesson was cutting open car locks and roofs in the event a victim was trapped inside or unconscious.

The Emergency Medical Technician (EMT) program is a two-week course designed to teach students the advanced basics of emergency medical procedures through classroom instruction and practical application.

Throughout the course, students learn how to deal with assorted medical emergencies such as carbon monoxide poisoning, diabetes, heart and lung emergencies, snake bites, shock, pediatrics, childbirth, and ear, nose and throat traumas. They also learn how to perform surgical emergencies and extracations.

"The program is new here at Kuwae Hospital, and we are in the process of having it nationally certified," said CDR Catharine Tate, Chief of Educational Services at the naval regional medical center. "The classes are made up mostly of volunteers; however, there are certain requirements." Any individual interested in the program must have at least eight to nine months left on the island, be CPR qualified, and use emergency medical procedures within his line of duty.

"Our goal is to keep 90-100 people trained at all times on the island, so we need individuals who will use this training every day on their job," said CDR Tate.

The most important part of the program is the practical application students receive. "You can't really learn these procedures just from textbooks and classroom discussions . . . it has to be through experience and actuality," explained LT Trowbridge. "Each student has a chance to participate

HM3 Cherie Kildow, right, moves her patient, LCPL Brian McLaughlin, back onto the car seat after a simulated car crash.

Students safely remove a "victim" from an overturned car during a simulated crash.

A student cuts through the roof of an overturned car during a simulated crash. Another student crawls underneath to check the vital signs of the trapped "victims."

and is graded on a pass/fail system."

On 14 Feb 1980, four students played victims of a helicopter crash. Their "wounds" were flesh-colored patches and masks tied to the head and other areas of the body. Even "blood" oozed from the wounds, adding to the realism and even horror of the situation.

A siren's mournful cry came from around the building as 10 EMTs pulled a table with medical supplies. The ambulance halted in front of the victims. All roles were played as real life and death situations they all knew they would be up against one day. One victim had broken legs, a severed hand, and was quickly going into shock. Another was suffering from head wounds, loss of blood, and broken legs. And still others were suffering from spinal injuries, and another from a protruding abdomen.

"Medic One to Base—come in Base," spoke one student to LT Trowbridge, the "backup physician."

"Go ahead Medic One," said LT Trowbridge.

"Base, we have a 21-year-old male here who was in a helicopter crash. His pulse is 120, blood pressure 90 over 60, respiration is 25. He has a possible fractured femur, request to start IV. His possible C-spine injury has already been treated, over.

"Medic One, start IV—125 ccs per hour, transport as soon as stable, over," answered back the base physician.

And so the procedures started. One EMT from each team called in his patient's vital signs and injuries to the "base unit physician" for backup medical support.

"I don't bother thinking that these are fake wounds, mainly because they look and seem so real," said HM3 Kildow, as she applied a clean, sterile dressing to a bloody wound. "I just do my job. But we all need the experience of handling simulated lifelike situations like these before we can handle the real thing."

One "patient" screamed out in pain. "I can't feel my legs. I can't feel anything—what's wrong with me." It may all be fake, but Mack's plea and tears aren't, as he adds realism for his fellow EMTs.

"You're going to be all right, Mack," said the EMT. "You're going to be all right."

—Story and photos by CPL Tracy Heuman, USMC □

Attention Physicians:

Don't just tell them to quit...

Studies confirm that 9 out of 10 smokers know that smoking is a bad habit. And they'd like to quit. But they don't know how.

The large majority of smokers indicate they would quit if their doctors told them to.

And studies confirm that a large proportion of patients have quit upon advice from their doctors.

However, about two-thirds of smokers report that they've never received advice on quitting from their doctors. It could be their doctors don't want to push them. Or maybe quitting is given a lower priority than other health problems.

But we believe a lot of doctors don't tell their patients to quit smoking for one simple reason: they don't know how to answer the inevitable "how."

The National Cancer Institute has developed a free "Helping Smokers Quit" kit to help you answer the "how" and to help your patients quit the smoking habit. Materials for this kit were pretested with the cooperation of the Harris County (Texas) Medical Society and M.D. Anderson Hospital and Tumor Institute in Houston, Texas.

The National Cancer Institute will provide the "Helping Smokers Quit" kit free of charge to all physicians who want to participate in this important effort. Included in the kit are guidelines for physicians, a self-test to help smoking patients determine why they smoke, pamphlets with tips on quitting, and waiting room posters to introduce the subject. Each kit contains enough materials to help 50 of your smoking patients who want to quit.

Show them how to quit.

Don't delay! To receive the National Cancer Institute's free "Helping Smokers Quit" kit, fill out this order form and return it today.

Part of the Navy "Clearing the Air" Program (NaCAP)

Department of the Navy

National Cancer Institute

I don't want to just tell them to quit.
I want to show them how to quit.
Please send me my free "Helping Smokers Quit" kit today.

Name_____

Address_____

City_____ State_____ Zip_____

Mail to "Helping Smokers Quit" Kit
Box NaCAP
National Cancer Institute
Bethesda, MD 20205

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Attention Dental Professionals:

Don't just tell them to quit...

Studies confirm that 9 out of 10 smokers know that smoking is a bad habit. And they'd like to quit. But they don't know how.

The large majority of smokers indicate they would quit if their doctors told them to.

And studies confirm that a large proportion of patients have quit upon advice from their doctors.

However, a lot of smokers report that they've never received advice on quitting from their dental professional. It could be their dentist, hygienist and/or assistant doesn't want to push them. Or maybe quitting is given a lower priority in patient education.

But we believe a lot of dental professionals don't tell their patients to quit smoking for one simple reason: they don't know how to answer the inevitable "how."

The American Dental Association and the National Cancer Institute have developed a free *Let's Help Smokers Quit* kit to help you answer the "how" and to help your patients quit the smoking habit. The kit has been tested by the Colorado Dental Association and has been proven to be effective.

The American Dental Association and the National Cancer Institute will provide the *Let's Help Smokers Quit* kit free of charge to all dental professionals who want to participate in this important effort. Included in the kit are guidelines for the dental professional, a self-test to help smoking patients determine why they smoke, pamphlets with tips on quitting, and waiting room posters to introduce the subject. Each kit contains enough materials to help 50 of your smoking patients who want to quit.

Show them how to quit.

Don't delay! To receive the American Dental Association and the National Cancer Institute's free *Let's Help Smokers Quit* kit, fill out this order form and return it today.

Part of the Navy "Clearing the Air" Program. (NaCAP)

National Cancer Institute

Department of the Navy

American Dental Association

I don't want to just tell them to quit.
I want to show them how to quit.
Please send me my free *Let's Help Smokers Quit* kit today.

Name _____

Address _____

City _____ State _____ Zip _____

Mail to:
Let's Help Smokers Quit
Office of Cancer Communications
Building 31, Room 10A18
Bethesda, Maryland 20205

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